I-95 CORRIDOR COALITION

WORK ZONE WEBINAR: CONNECTED VEHICLE WORK ZONE PILOT & WORK ZONE MONITORING TOOLS

April 19, 2018

PENNA TURN PIKE

TRANSCOM℠
TRANSPORTATION OPERATIONS COORDINATING COMMITTEE

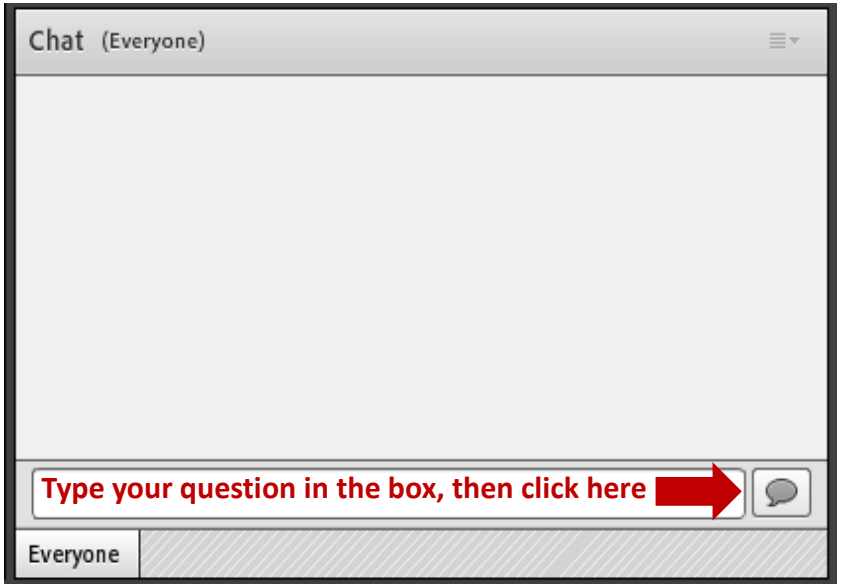
CATT LABORATORY

Webinar & Audio Information

- The call-in phone number is: **1-xxx-xxx-xxxx & enter xxxxxxx# at the prompt**
- **Participants will be in "Listen Only" mode throughout the webinar**
- Please press *0 to speak to an operator for questions regarding audio
- Please call xxx-xxx-xxxx for difficulties with the web or audio application
- This webinar will be recorded
- Presentations will be posted to the I-95 Corridor Coalition website. Participants will receive a link to the presentations after they are posted.

Asking Questions

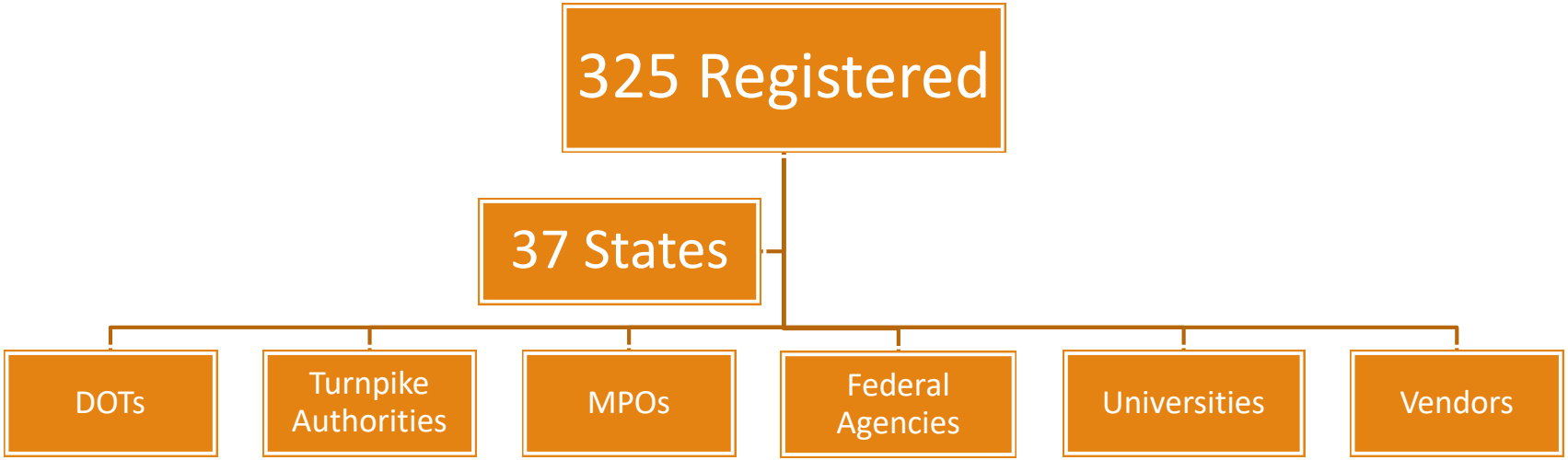
- Please pose your questions using the **chat box**
- Questions will be monitored then answered by the speakers at the end of the webinar



Welcome

Welcome & Overview	Denise Markow, PE I-95 Corridor Coalition
Slow Moving Vehicle Warning System	Amber Reimnitz, PMP Pennsylvania Turnpike Commission
Connected Work Zone Pilot	Mike Pack Pennsylvania Turnpike Commission
SPATEL Tool and the Queens Midtown Tunnel	Robert Glantzberg TRANSCOM
Improving Work Zone Safety and Mobility	Nikola Ivanov, PMP University of Maryland CATT Lab

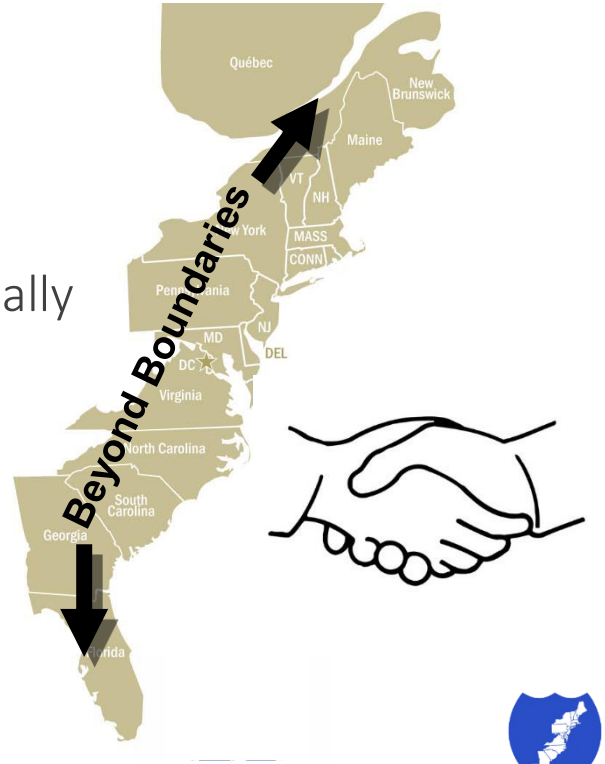
I-95 Corridor Coalition Sponsored Event



Who is the I-95 Corridor Coalition?

- 16 States and the District of Columbia
- 35% of nation's VMT (21% of road miles)
- 565 million long-distance (>100 miles) trips annually
- Corridor = third largest economy in world

How can we better message TSMO strategies Regionally?



…a partnership of multi-state, multi-modal public agencies working together to create a seamless and efficient transportation system

Introductions

Denise Markow, PE

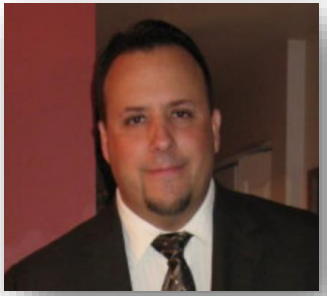
I-95 Corridor Coalition

TSMO Director

Amber Reimnitz, PMP

Pennsylvania Turnpike Commission

Sr. Traffic Operations Project Manager



Mike Pack

Pennsylvania Turnpike Commission

Manager of Incident Management and Traffic Operations

Robert Glantzberg

TRANSCOM

Director of Operations

Nikola Ivanov, PMP

University of Maryland CATT Lab

Deputy Director

SLOW MOVING VEHICLE WARNING SYSTEM

Amber Reimnitz, PMP
Pennsylvania Turnpike Commission

SLOW MOVING VEHICLE WARNING SYSTEM

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ABOUT THE PA TURNPIKE

- Miles – **552**
- Vehicles/year – **198,536,011**
- Vehicles/day – **543,943**
- Interchanges – 80 (68 Toll locations)
- Characteristics – 4 lane moving to 6 lanes along I-76/I-276/I-476
- Tunnels – 5; 2 lanes/tube – 2 tubes/tunnel

NEED

- High number of accidents within our **long term work zones**
- High percentage were classified as **rear-end collisions**
- Extremely high rate of **Truck Mounted Attenuators struck**
- **Long term construction projects** with lane restrictions range from 18 months – 36 months
- Extended construction duration = **decreased driver awareness**
- **Excessive speeding within work zones**

STATISTICAL DATA

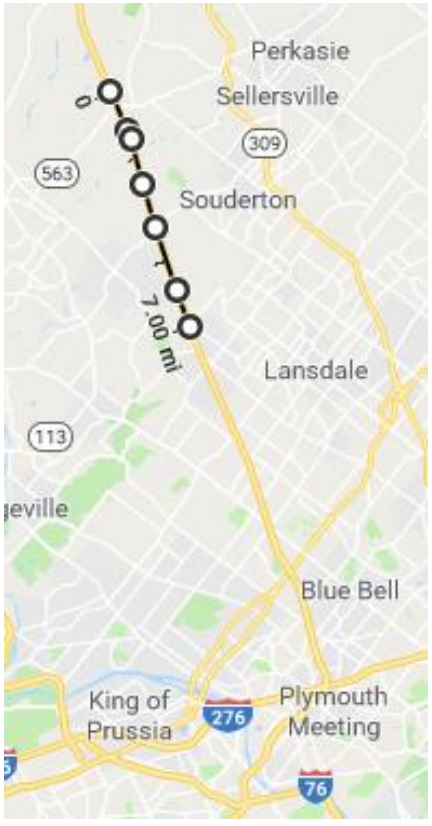
- **PTC Work Zone Crash Data (FY12-FY17)**
  - 284 Total Crashes
  - 29% Rear-end Crashes
- **PTC Crash Cluster Data (2012-2014)**
  - 20 Crash Clusters
  - 5% Potential Connection to Work Zones
- **FY14-FY17 Attenuator Hits - 76 Total Crashes**
  - 16% Moving Operations
  - 43% Stationary Operations
  - 41% During Work Zone Set Up / Removal Operations

TIMING

January 2016	Initiated Scope of Work for a study for the feasibility of Smart Construction Vehicle Entrance utilizing actuated notifications
February 2017	Notice to Proceed to start on a Concept of Operations and pilot design
June 2017	Finalized Concept of Operations
June 20, 2017	Documented proof of accident involving a construction vehicle exiting highway into construction entrance being struck by a Tractor Trailer

TOTAL RECONSTRUCTION A31-A38

- **6 lane widening** along I-476
- **NTP:** November 2017
- **Completion:** November 2020
- Cost: $224,929,880

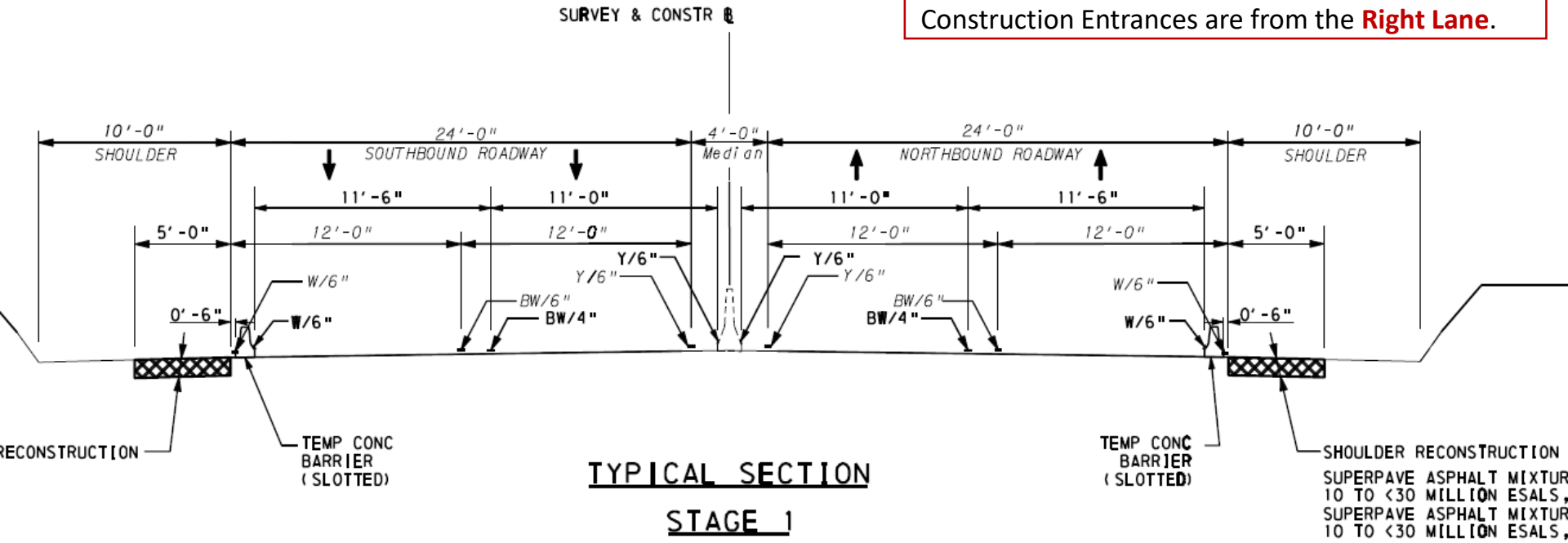


MPT STAGE 1 – SHOULDER RECONSTRUCTION

Traffic experiences reduced lane widths.

Trucks/Buses **Right Lane Only.**

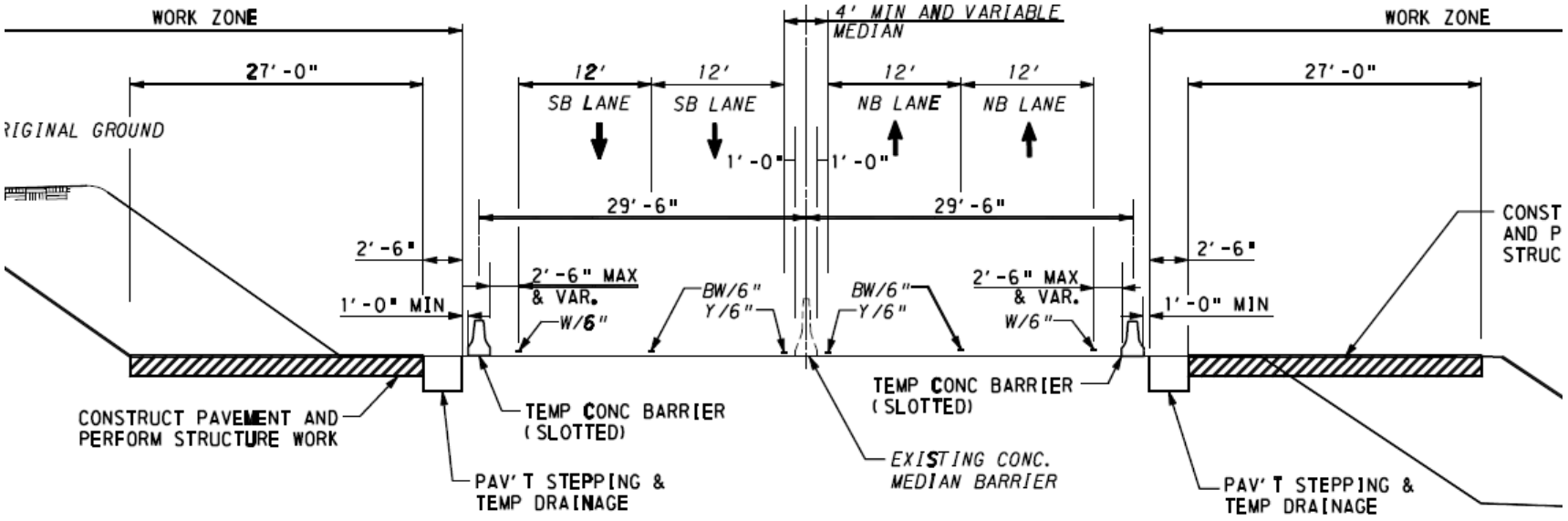
Construction Entrances are from the **Right Lane**.



TYPICAL SECTION

STAGE 1

MPT STAGE 2 – TRAFFIC INSIDE LANES



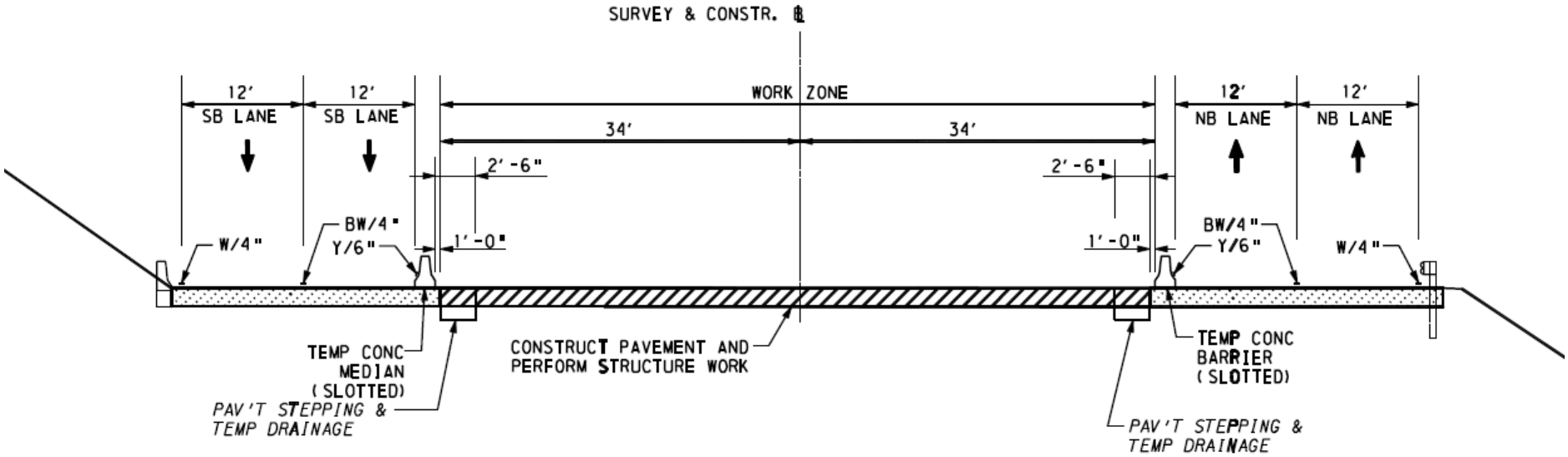
TYPICAL SECTION

STAGE 2

ORIGIN

Construction Entrances are from the **Right Lane**.
Barrier is in place for the length of the project, 7 miles.
No restrictions

MPT STAGE 3 – TRAFFIC OUTSIDE LANES



TYPICAL SECTION

STAGE 3

Trucks/Buses **Left Lane Only.**
Construction Entrances are from the **Left Lane**.

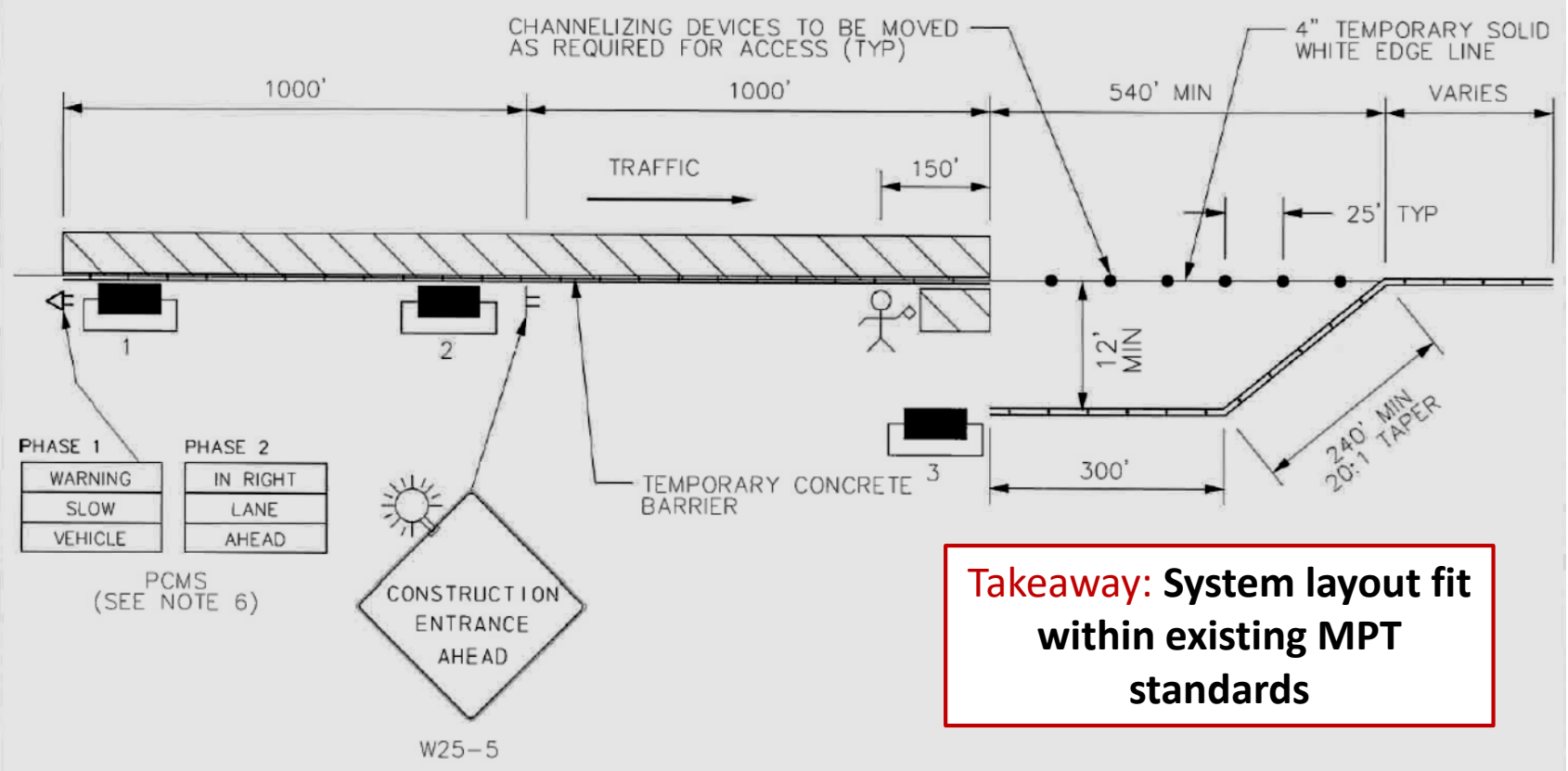
SPECIFICATION REQUIREMENTS

- System to be completely localized
- System will be relocated with each construction stage – **3 stages**
- Components:

Roadside Detectors	Programmable Logic Controllers	PCMS
Wireless Communications	Fob Remote Transmitter	

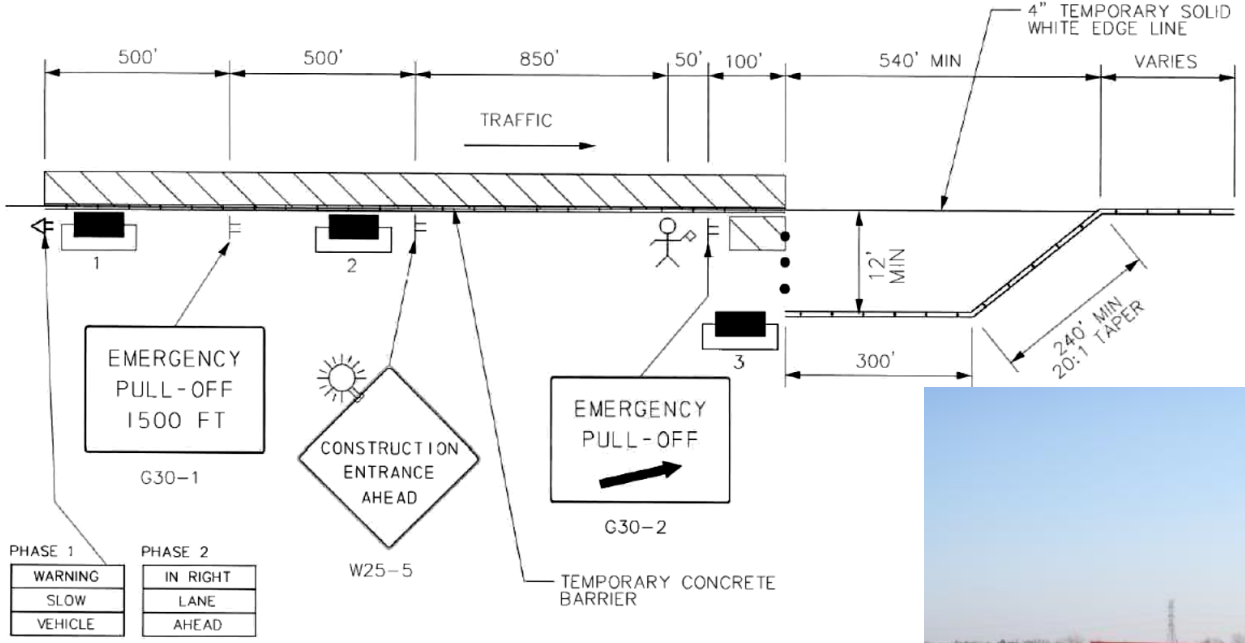
- Detection zone 1 &2 – Mainline traffic
  - If **speed > 10 mph less than** posted speed – activate warning message
- Activation: Fully configurable
  - Vehicle exiting the Mainline into construction area – **60 sec**
  - Vehicle entering the Mainline from construction area – **120 sec**
  - Fob remote activation – **120 sec**
- System must be repaired & operational **within 24 hours** of notice of error/damage/issues

STANDARD LAYOUT – CONSTRUCTION ACCESS



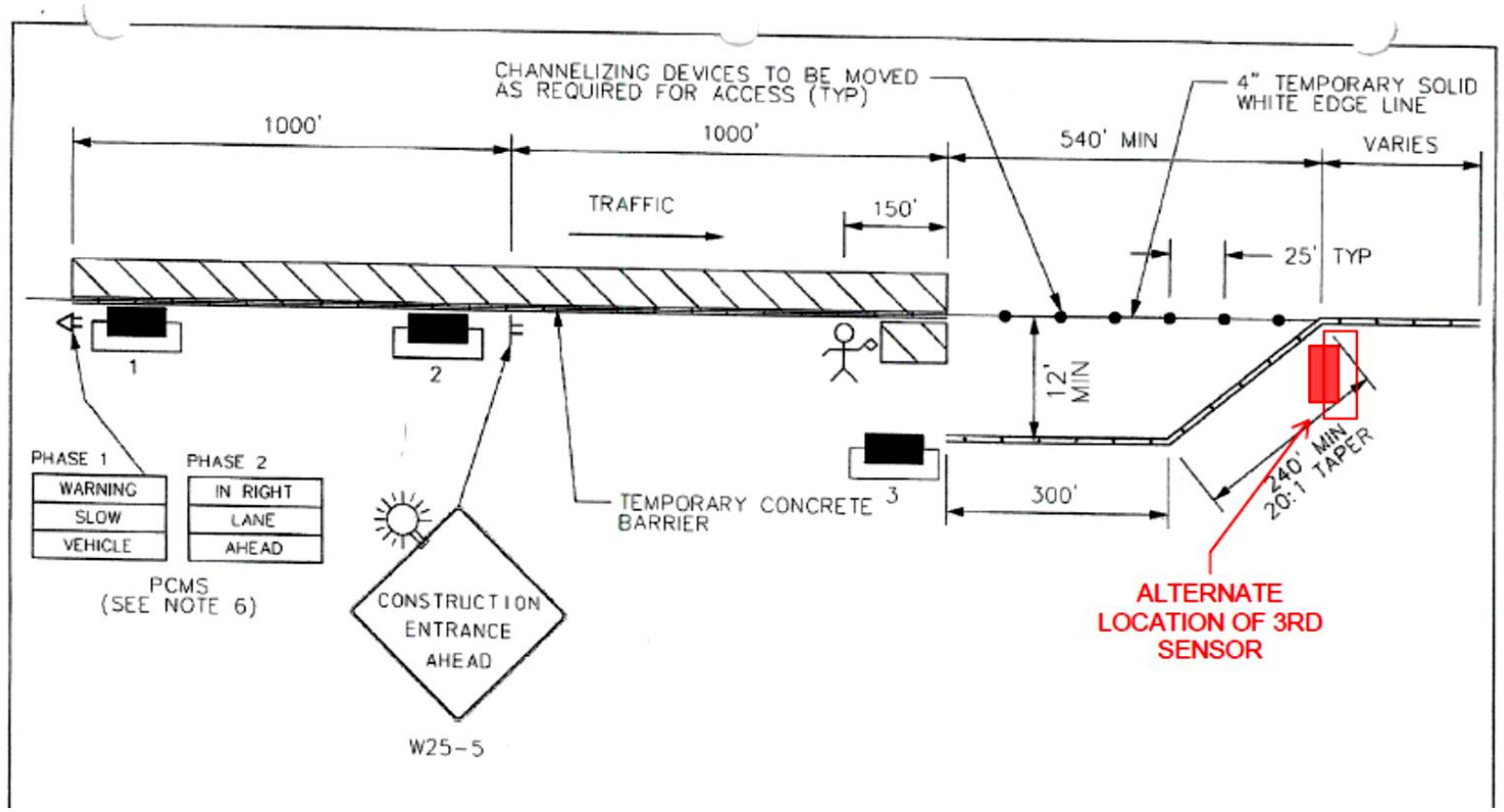
Takeaway: **System layout fit within existing MPT standards**

STANDARD LAYOUT WITH EMERGENCY PULL OFF

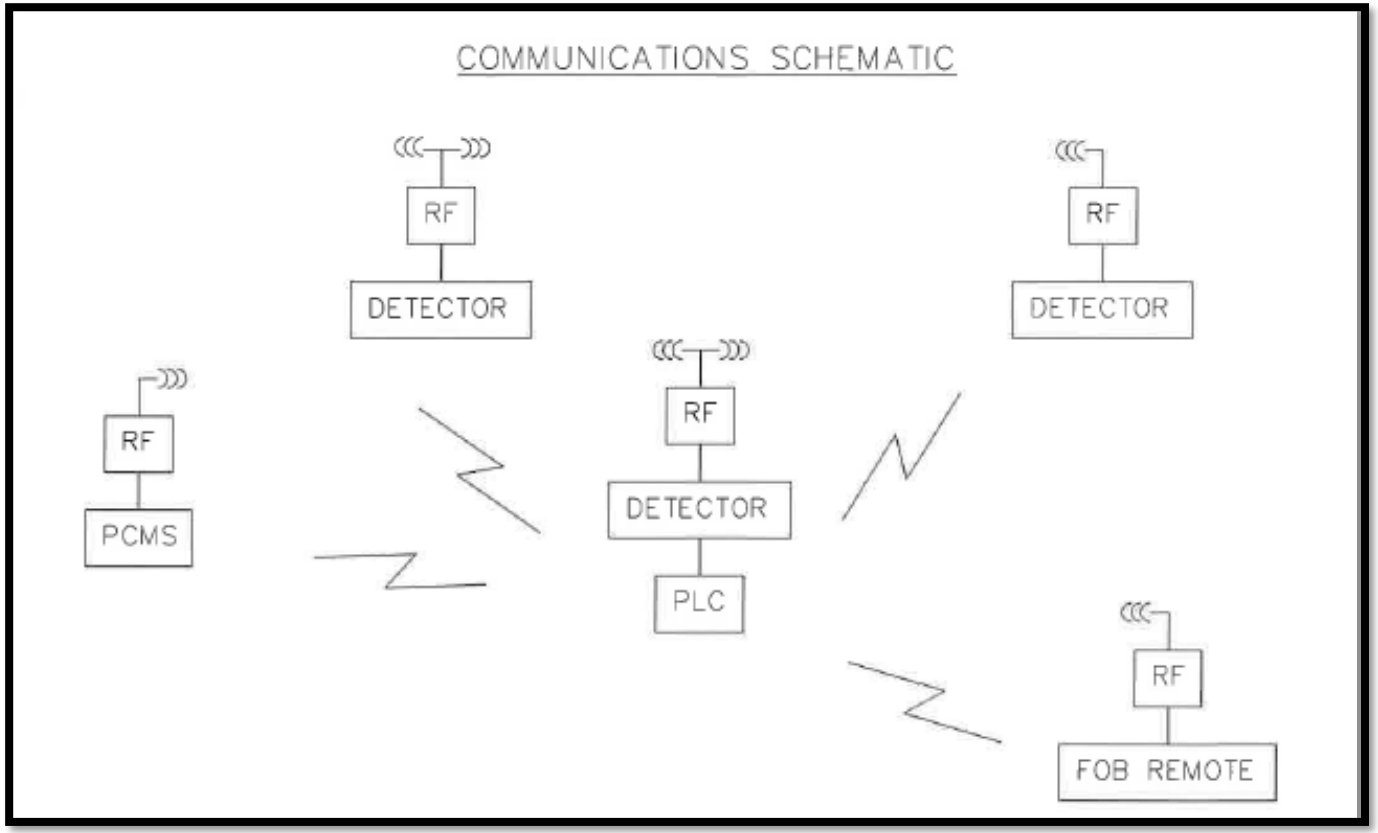


Additional Signage for the system to compete with

VENDOR SUBMISSION - LAYOUT

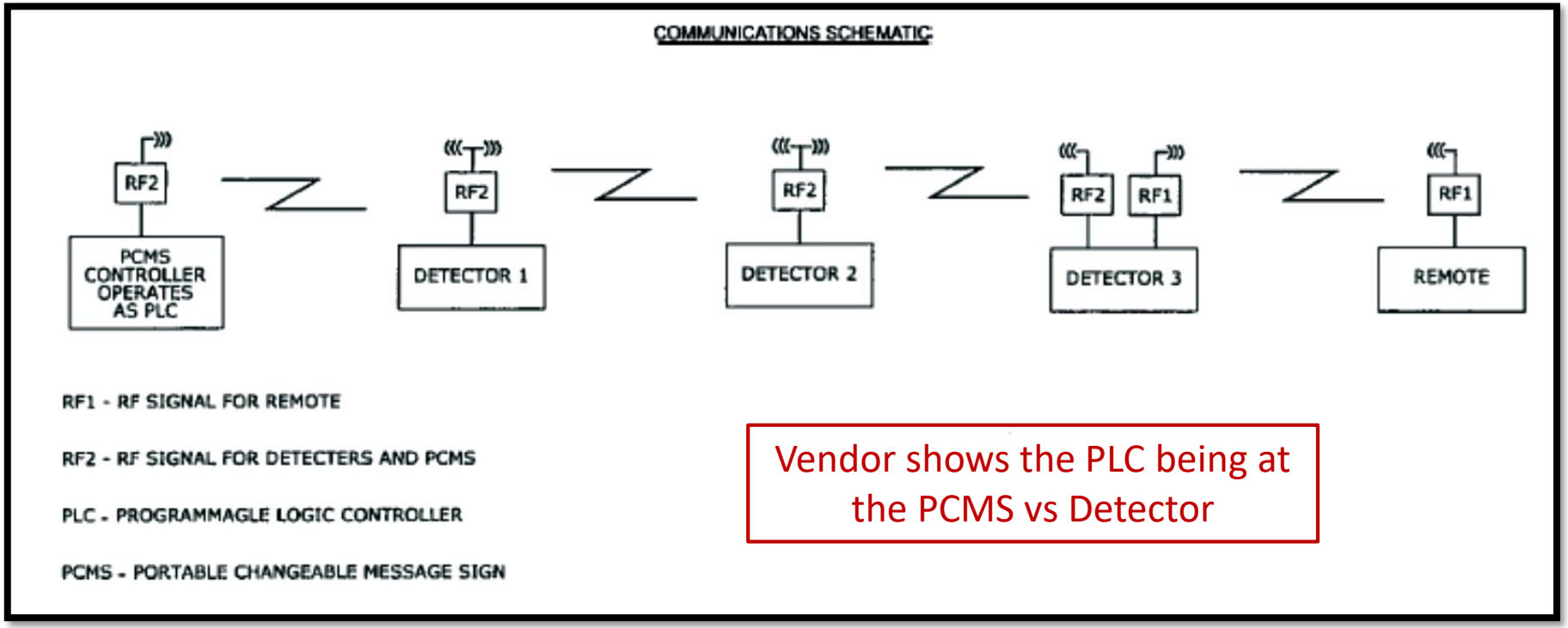


STANDARD LAYOUT COMMUNICATION SCHEMATIC



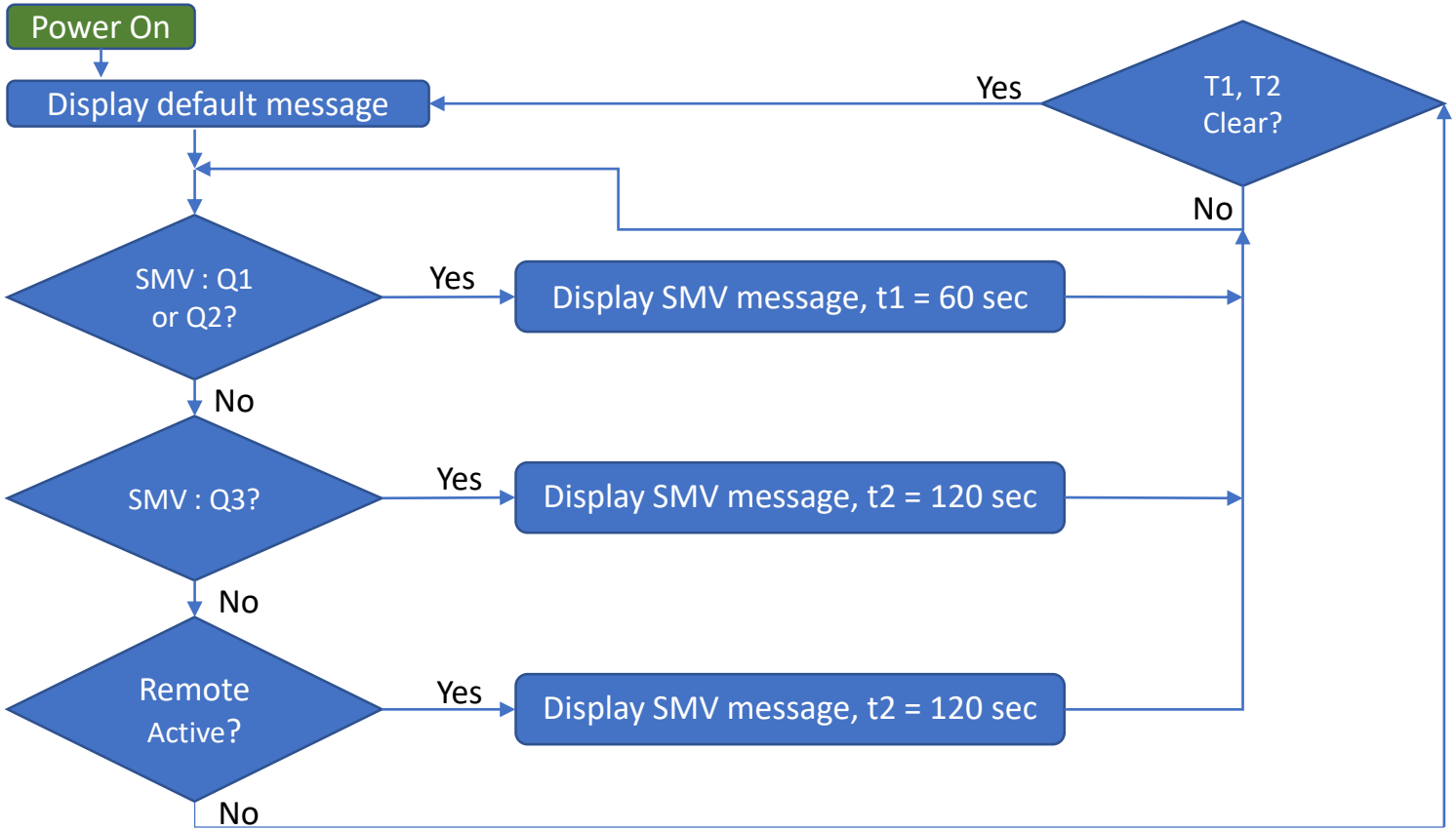
Basic layout showing all detections going directly to the PLC

VENDOR SUBMISSION – COMMUNICATION SCHEMATIC



Vendor shows the PLC being at the PCMS vs Detector

VENDOR SUBMISSION – CONTROL LOGIC



Proof of concept works through the logic

EVALUATION

- **Reports**
  - Usage Report (activations)
  - System Downtime Report
  - Maintenance Report
  - Crashes
- **Analysis**
  - Overall effectiveness (stakeholder input)
  - Cost – Bid price was $1.5Millon over 36 months; **$2,777/mo./entrance**
  - Effect on the number of crashes involving slow moving vehicles and general traffic flow
  - Compare crash history of A26-A31 Total Reconstruction
- **Final Recommendations**

QUESTIONS?

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CONNECTED WORK ZONE PILOT

Mike Pack
Pennsylvania Turnpike Commission

PA Turnpike Commission
Connected Work Zone Pilot

Michael Pack
Manager of
Incident Management
and Traffic Operations

Agenda

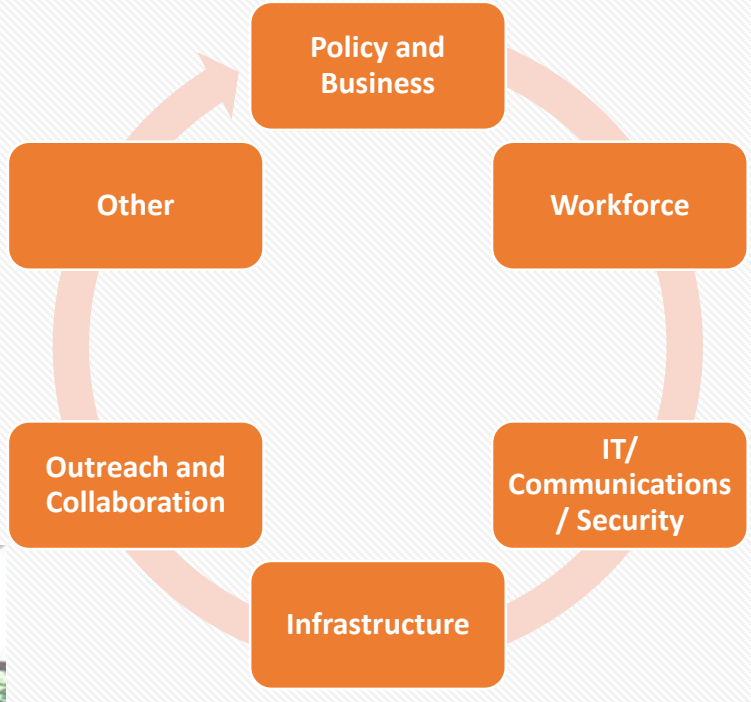
- PA Turnpike CAV Roadmap
- Connected Work Zone Pilot
- Next Steps

PA Turnpike CAV Roadmap

- Project executed February 2016
- Prime – AECOM
  - Subs – Information Logistics and TTI
- Roadmap Tasks:
  - Research current standards and best practices
  - Identify potential projects for short/mid/long term
  - Align with capabilities of PTC infrastructure readiness, planned projects, and in-house capabilities
  - Develop Implementation plan, starting with a “Quick Win” project
- Roadmap completed April 2017
- Executed CV pilot project in January

CAV Foundational Needs

- Refine operational vision and proposed focus areas
- Identify foundational needs
- Identify short-term pilot projects
- Plan for future projects
- Develop an operations and maintenance strategy for applications



Connected vs Autonomous

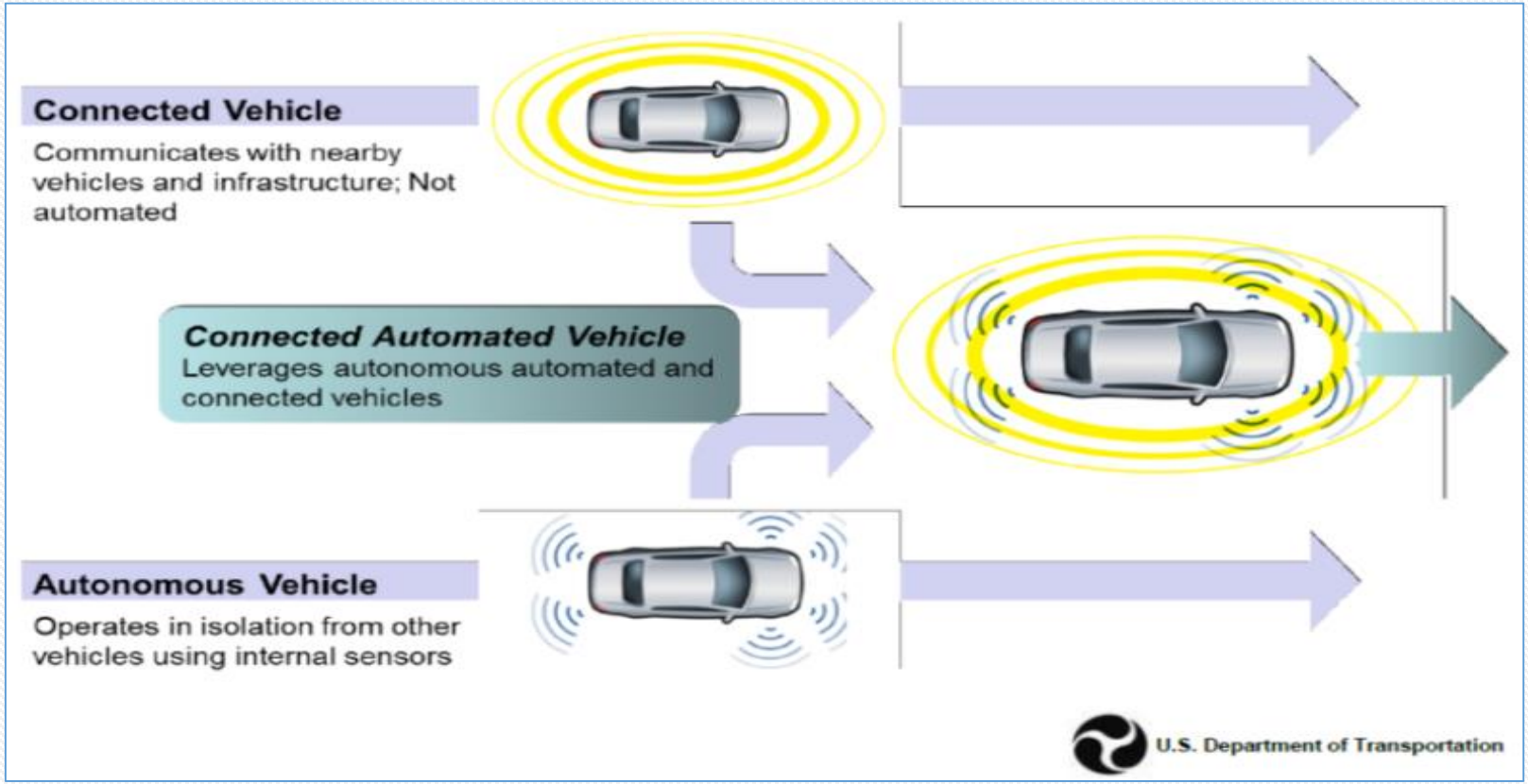


Figure 1. What are Connected and Automated Vehicles?

Application Priorities

Short-Term 0-4 Years	Mid-Term 4-10 Years	Long-Term Beyond 10 Years
• Warnings about Upcoming Work Zone (Work Zone Safety) • Advanced Traveler Information Systems (Traveler Information) • Incident Scene Work Zone Alerts for Drivers and Workers (Traffic Incident Management) • Electronic Toll Collection (Tolling) • Reduced Speed Zone Warning/Lane Closure (Work Zone Safety) • Traveler Information-Smart Parking (Traveler Information) • Curve Speed Warning (Roadway Safety) • Spot Weather Impact Warning (Road Weather Safety)	• Incident Scene Pre-Arrival Staging Guidance for Emergency Responders (Traffic Incident Management) • Road Weather Information for Maintenance and Fleet Management Systems (Road Weather Safety) • Variable Speed Limits for Weather-Responsive Traffic Management (Road Weather Safety) • Road Weather Motorist Alert and Warning (Road Weather Safety) • In-Vehicle Signage (Traveler Information) • Queue Warning (Roadway Safety) • Warnings about Hazards in a Work Zone (Work Zone Safety)	• Speed Harmonization (SPD-HARM) (Traffic Network) • Road Use Charging (Congestion Pricing) • Vehicle Data for Traffic Operations (Traffic Network) • Performance Monitoring and Planning (Traffic Network) • Enhanced Maintenance Decision Support System (Traffic Network) • Advanced Automatic Crash Notification Relay (EVAC) (Traffic Incident Management) • Road Weather Information and Routing Support for Emergency Responders (Traffic Incident Management)

Short Term Projects – Quick Wins

CAV Safety Core Focus Areas	CV Applications	"Quick Win" Projects
Work Zone Safety Traffic Incident Management Roadway Safety Road Weather Safety	▶ Warnings about Upcoming Work Zone ▶ Incident Scene Work Zone Alerts for Drivers and Workers ▶ Reduced Speed Zone Warning/Lane Closure ▶ Curve Speed Warning ▶ Spot Weather Impact Warning	**Option 1 (Pick One):** Mobile and Maintenance Patterns Warning (Line Painting; MP 319-326; MP 202-206) Curve and Ramp Warning Systems (Breezewood Interchange) Road Weather Information Systems (Mile Marker 288) **Option 2:** Connected Truck Mounted Attenuator Pilot

Why start with Work Zone Pilot?

Connected WZ Goal – Reduce WZ Crashes

Work Zone Crash Summary

Fiscal Year - Total*

Fiscal Year	Work Zone Total Crashes			Work Zone Fatal Crashes		Vehicle Miles Traveled (Crashes per MVMT)		Capital Spending (Crashes per Million)	
	Total	Injury	PDO**	Total	Person	MVMT	Rate	Cost (M)	Rate
FY2013	282	118	162	2	2	6,086.3	0.046	$430.6	0.65
FY2014	214	70	141	3	3	6,143.3	0.035	$422.7	0.51
FY2015	267	100	162	5	5	6,296.4	0.042	$547.3	0.49
FY2016	327	103	220	4	4	6,504.0	0.050	$684.4	0.48
FY2017	283	86	197	0	0	6,562.0	0.043	$564.9	0.50
FY2018***	91	27	63	1	1	3,013.5	0.030	$257.3	0.35
Average	275	95	176	3	3	6,318.4	0.044	$530.0	0.52

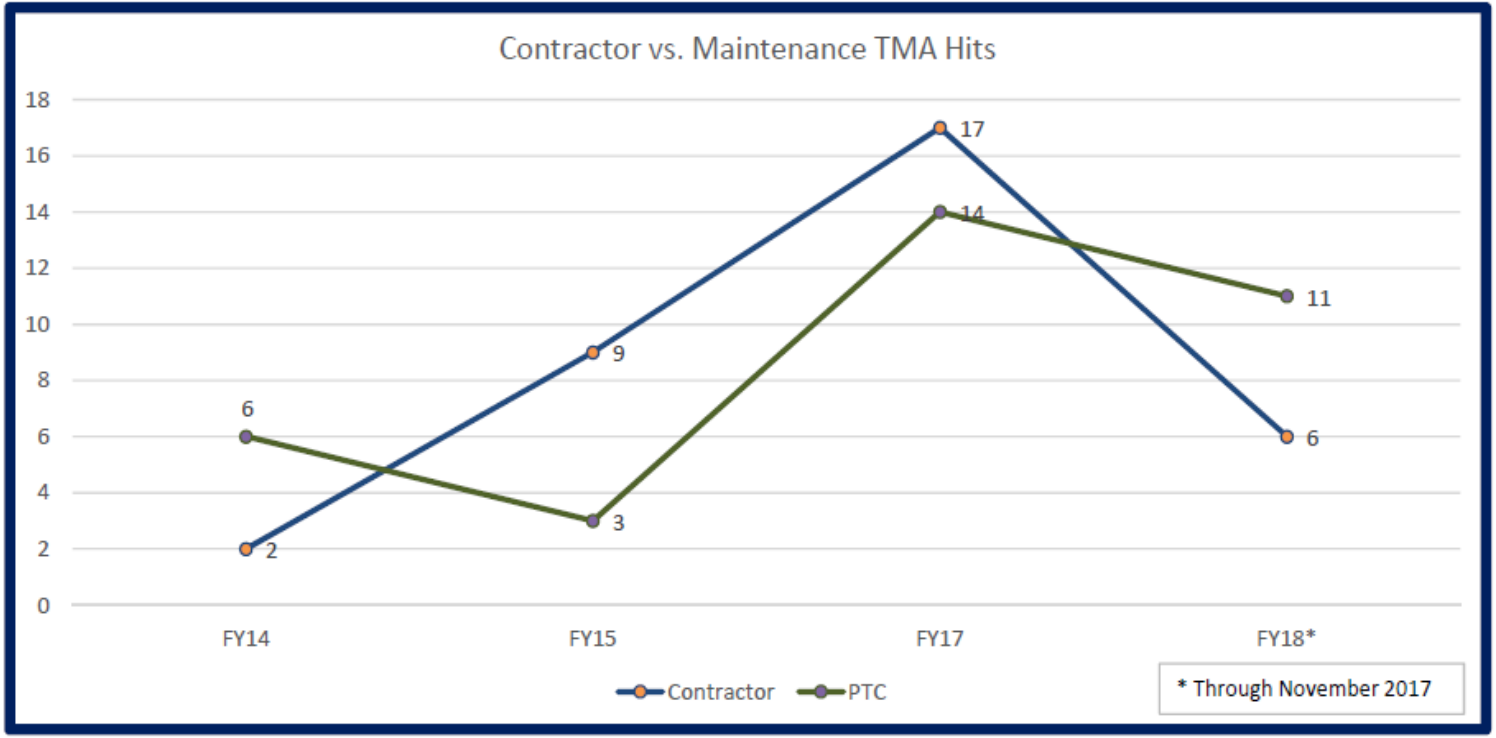
* June 1st through May 31st

** Property Damage Only

*** FY2018 Q2 incomplete (includes Q2 data through 31-Oct-2017)

Why start with Work Zone Pilot?

Connected WZ Goal – Reduce Truck Mounted Attenuator Hits



Why start with Work Zone Pilot?

- Work zones present significant safety and capacity issues
  - Average 275 WZ accidents / year
  - Average 20 TMA hits / year
- Contributing factors
  - Speed
  - Distracted Driving
  - Aggressive Driving
  - Under the influence
  - Ignore Work Zone signs

  “D” Drivers

Project Overview

Project Team

Prime – Gannett Fleming

Subs – Iteris; Information Logistics

- Project Objectives
  - Communicate work zone information from PTC Maintenance Vehicle via DSRC
  - Communicate work zone information from PTC Maintenance Vehicle to Waze
  - Install and Operate On Board Unit (OBU) on PTC Maintenance Vehicle in typical operational environment – **no interaction needed from Operator**
- Operational Scenarios
  - Stationary work zone
  - Short duration work zone
  - Mobile work zone

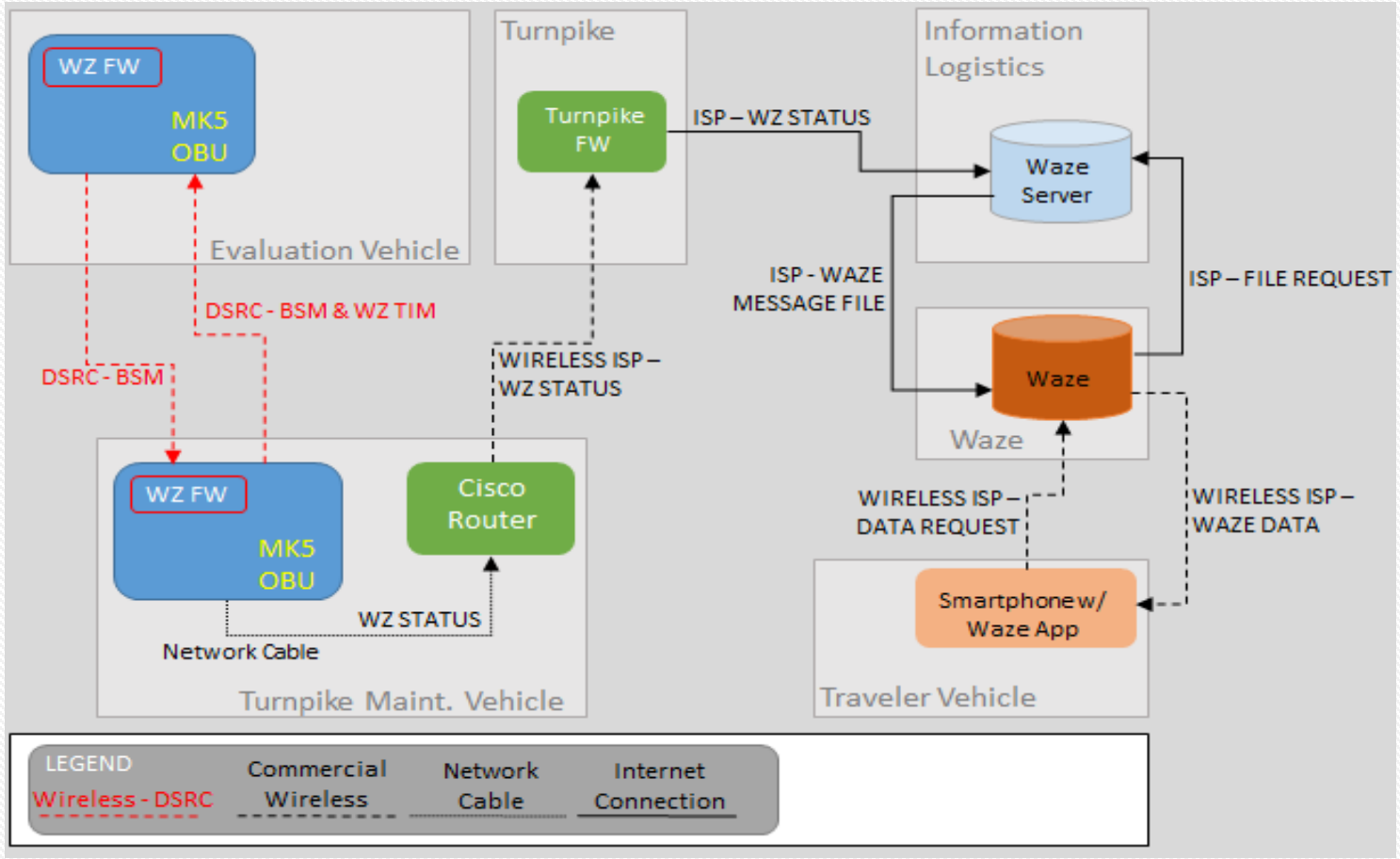
System Design – Components

- Cohda MK5 OBU
  - Communicate with other road users
- Cohda MK5 OBU firmware (Significant modifications)
  - Developed to generate and process work zone messages
- Cisco IR809 router (No modifications)
  - Connects the OBU to the PTC server
- PTC Server (Minor modifications)
  - Enhanced to provide customized messages for retrieval by Waze
- Waze service and smartphone application (No modifications)
  - Waze will need to poll more frequently

ns

Figure 1. Cisco 809 Industrial Integrated Services Routers

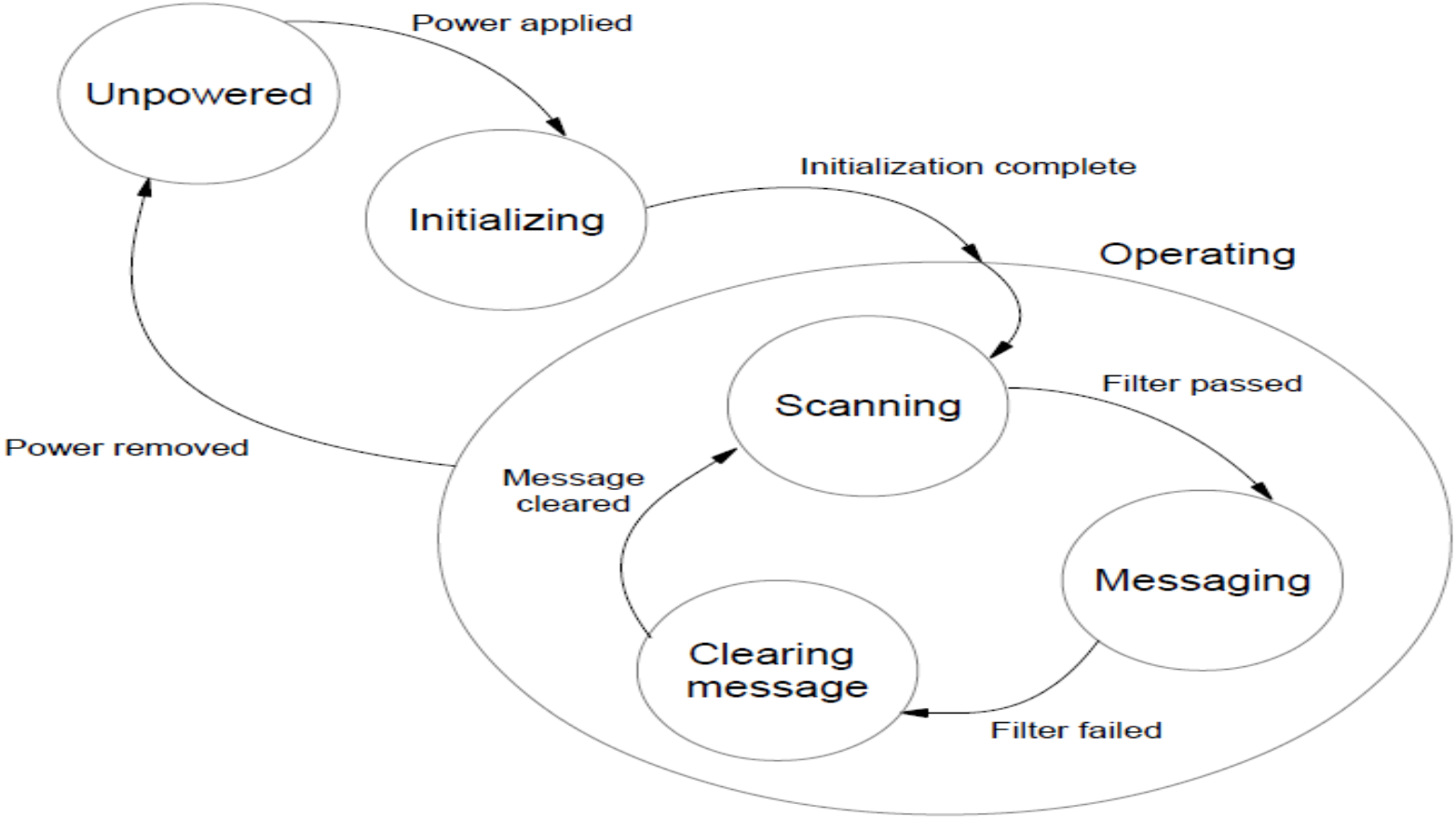
System Architecture



System Design – PTC Maintenance Vehicle

- Cohda OBU, Cisco router, and associated antennas will be installed on a truck mounted attenuator (TMA) maintenance vehicle
- The OBU will transmit work zone messages structured as Traveler Information Messages and Basic Safety Messages (BSMs)
- The OBU will also accept BSMs from other nearby OBUs and keep count of DSRC-capable devices on the Turnpike that communicate with the PTC maintenance vehicle

System Design – Messaging



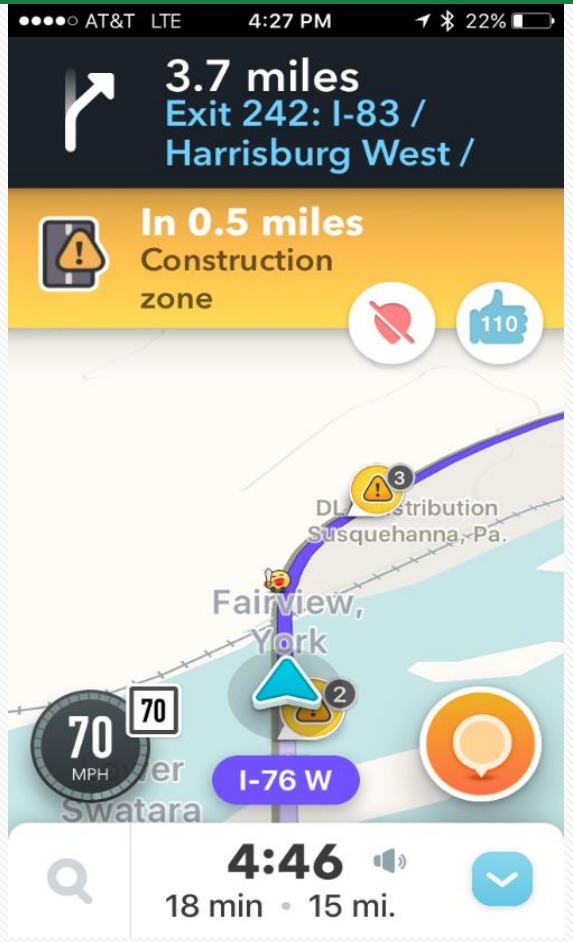
System Design – Messaging

- The OBU will transmit work zone messages structured as Traveler Information Messages and Basic Safety Messages (BSMs)

WORK ZONE ON PENN TURNPIKE
MOBILE WORK ZONE ON PENN TURNPIKE AHEAD

- Lane-specific messages will not be transmitted during pilot due to unknown accuracy
- The OBU will also accept BSMs from other nearby OBUs and keep count of DSRC-capable devices on the Turnpike that communicate with the PA Turnpike Commission maintenance vehicle

System Design – Server and Waze Services



- PTC is a Connected Citizens Partner
- The server will be enhanced to process customized work zone messages sent by PTC maintenance vehicle OBU and router
- Waze has a new moving vehicle feed which may be used in this pilot
- Waze will poll the server every 1 - 10 seconds

Evaluation Plan

- Evaluation period will be mid-July to November
- Evaluation team will have OBU-equipped vehicle and will drive through each operational scenario multiple times
- Evaluation team will note:
  - Traffic conditions/congestion
  - Roadway characteristics – vertical/horizontal curvature
  - Lane/shoulder position of maintenance vehicle
  - Speed
  - Weather conditions
  - Vegetation/bridges/roadway environment
  - Potential occlusion/obstructions
  - Etc.

Evaluation Metrics

Number	Needs / Functional Elements	Metric
1	Maintenance and construction operations need to be able to inform the driver of upcoming work zones, and	Percentage of messages transmitted from work zone posted to Waze and V2V
1.01	inform the driver of reduced speeds,	Percentage of messages transmitted from work zone posted to Waze and V2V
1.02	inform the driver of lanes affected	Percentage of messages posting correct lane
1.03	inform the driver of delays	Percentage of messages transmitted from work zone posted to Waze and V2V
1.1	Information needs to be delivered to drivers in or near the work zone (within 0.1 miles)	Distance in feet/ fraction of mile
1.2	Information need to be delivered to PTC staff in OBU-equipped vehicles in or near the work zone (within 0.1 miles)	Distance in feet/ fraction of mile
1.3	Drivers need to be able to receive messages through the Waze commercial smart phone application for stationary work zones and	Percentage of messages transmitted from work zone posted to Waze and V2V
1.31	Receive messages for mobile work zones	Percentage of messages transmitted from work zone posted to Waze and V2V
1.4	Drivers receiving information via Waze regarding mobile work zones need to receive the information prior to reaching the active work zone area	Distance in feet/ fraction of mile
1.5	Drivers receiving information via Waze need to receive information regarding short-duration work zones at least 0.3 miles prior to the work zone	Distance in feet/ fraction of mile
1.6	Information provided to drivers in relevant direction of travel	Drivers going in proper direction receive work zone information
1.7	Warning distance V2V comms from maintenance vehicle to approaching evaluation vehicle	Distance in feet/ fraction of mile
1.8	Waze accuracy for mobile work zone	Distance traveled by maintenance vehicle from time of transmission to time posted on Waze
1.9	Message Latency for Waze	Time elapsed between time message was transmitted and time message posted on Waze
1.10	Number of vehicles equipped with DSRC capable devices on Turnpike that communicate with the maintenance vehicle OBU or the evaluation vehicle	Count

Alternative Design Considerations

- Consideration was given to using a Roadside Unit (RSU) in place of the OBU for stationary work zone
- Consideration was also given to processing messages with the Cisco router instead of the OBU

Pilot Schedule

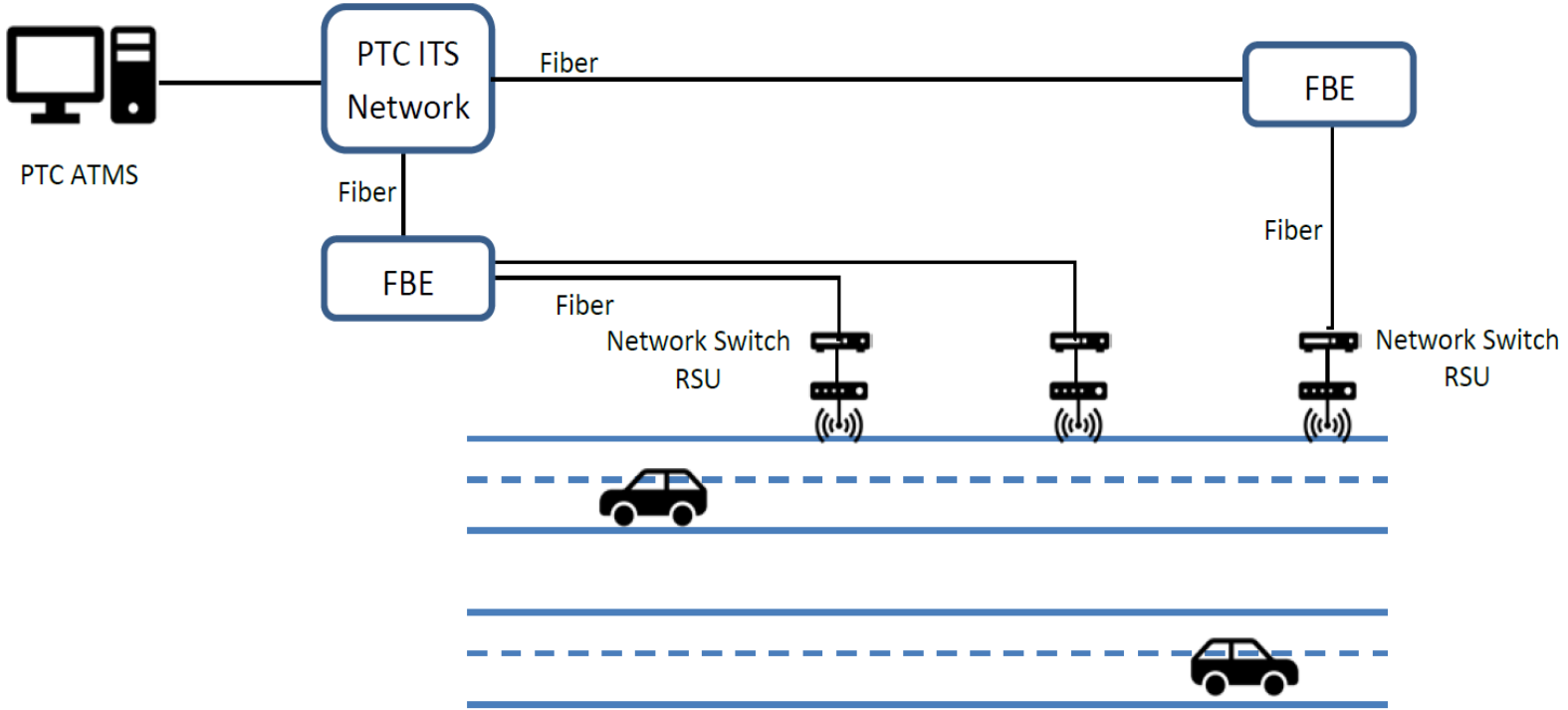
- System go-live by mid-July
  - Software / Firmware development
  - Traveler Information Application Integration
  - Vehicle installation
  - System Integration and Testing
- Evaluate
  - July through November

CV Next Steps

- Developing DSRC architecture and Specification
- Potential short-term DSRC Installations
  - Interchanges
  - Mainline curves and Interchange Ramps
  - Tunnels
  - Traffic Count Stations
  - Weather “Hot Spots”
- IT Unit purchased DSRC units to configure / test

DSRC Long Term Architecture Concept

Example Network Deployment Architecture



Questions??

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SPATEL TOOL AND THE QUEENS MIDTOWN TUNNEL

Robert Glantzberg
TRANSCOM

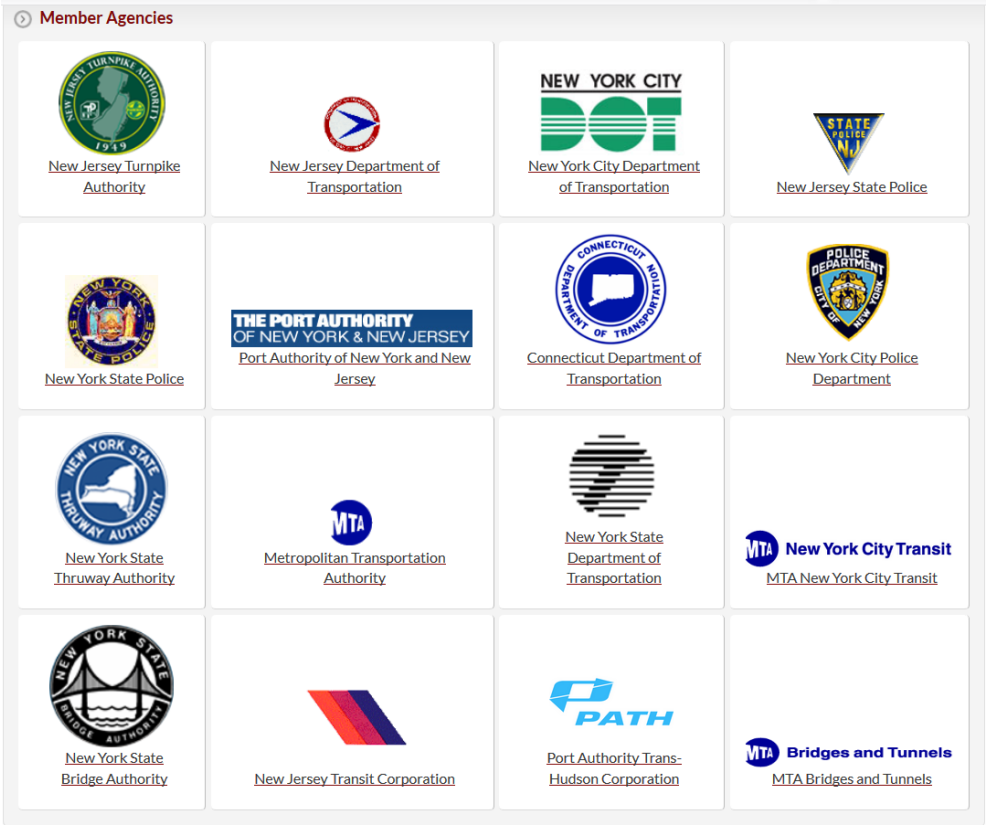
TRANSCOM℠
TRANSPORTATION OPERATIONS COORDINATING COMMITTEE

I-95 Corridor Coalition's Work Zone Webinar

TRANSCOM's SPATEL Tool and the QMT

TRANSCOM

- TRANSCOM is a coalition of 16 transportation and public safety agencies in the New York – New Jersey – Connecticut metropolitan region. It was created in 1986 to provide a cooperative, coordinated approach to regional transportation management.



Mission

- TRANSCOM improves the mobility and safety of the traveling public by supporting its member agencies through interagency communication and the enhanced utilization of their existing traffic and transportation management systems. Further, as additional systems become available, TRANSCOM is a forum for ensuring that they are implemented in a coordinated manner.

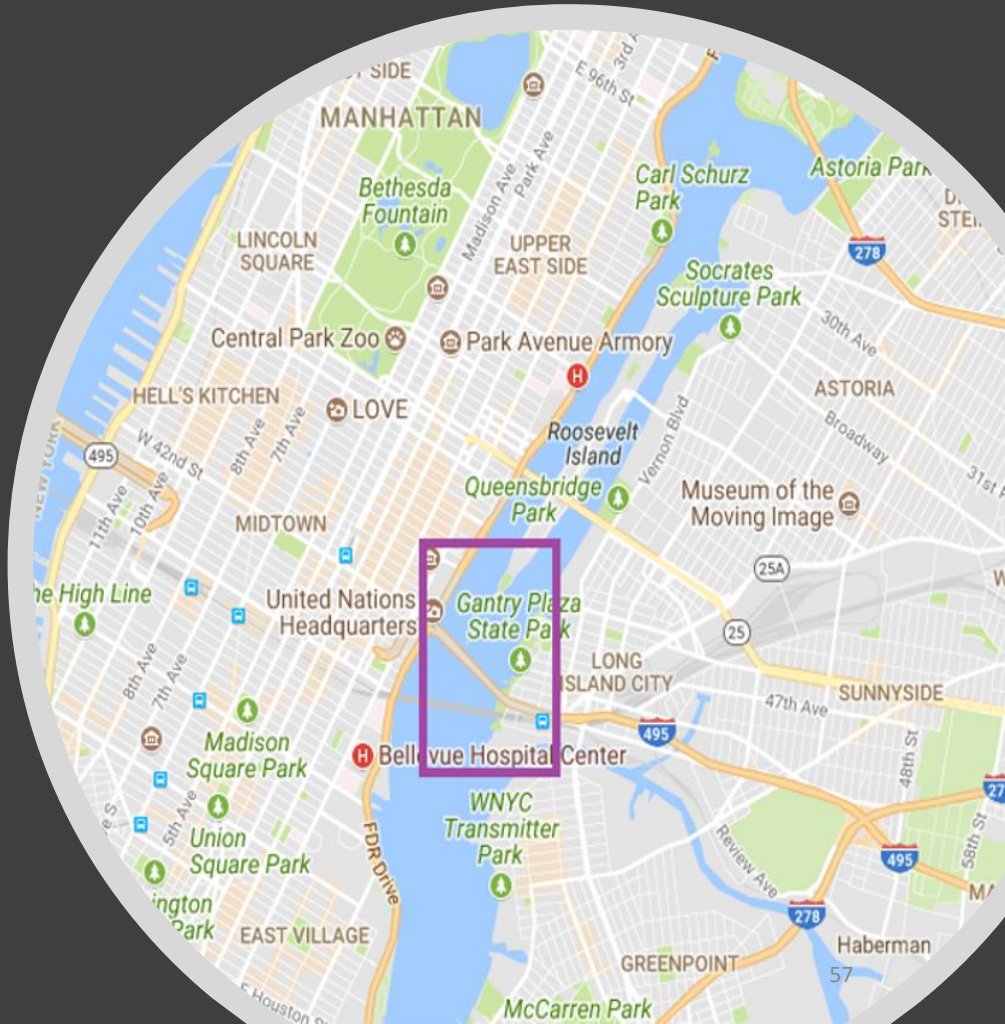
TRANSCOM's SPATEL System

- **S**elected
- **P**riorities
- **A**pplied
- **T**o
- **E**valuated
- **L**inks

The Links (to be evaluated)

- TRANSCOM's TI-MED System: Traffic Information – Measured, Evaluated, Distributed
  - Formerly was known as TRANSMIT (readers in NY and NJ)
- BlueTooth (multiple providers; readers in NY and NJ)
- HERE (NY/NJ/CT – statewide; Surrounding Philadelphia/Northern DE)
- INRIX (NJ, Philly. NYC soon)
- NJ Turnpike's Puck System
- Capable of supporting other technologies

Queens Midtown Tunnel




SANDY
WAS HERE
10/2012

Sandy and the QMT

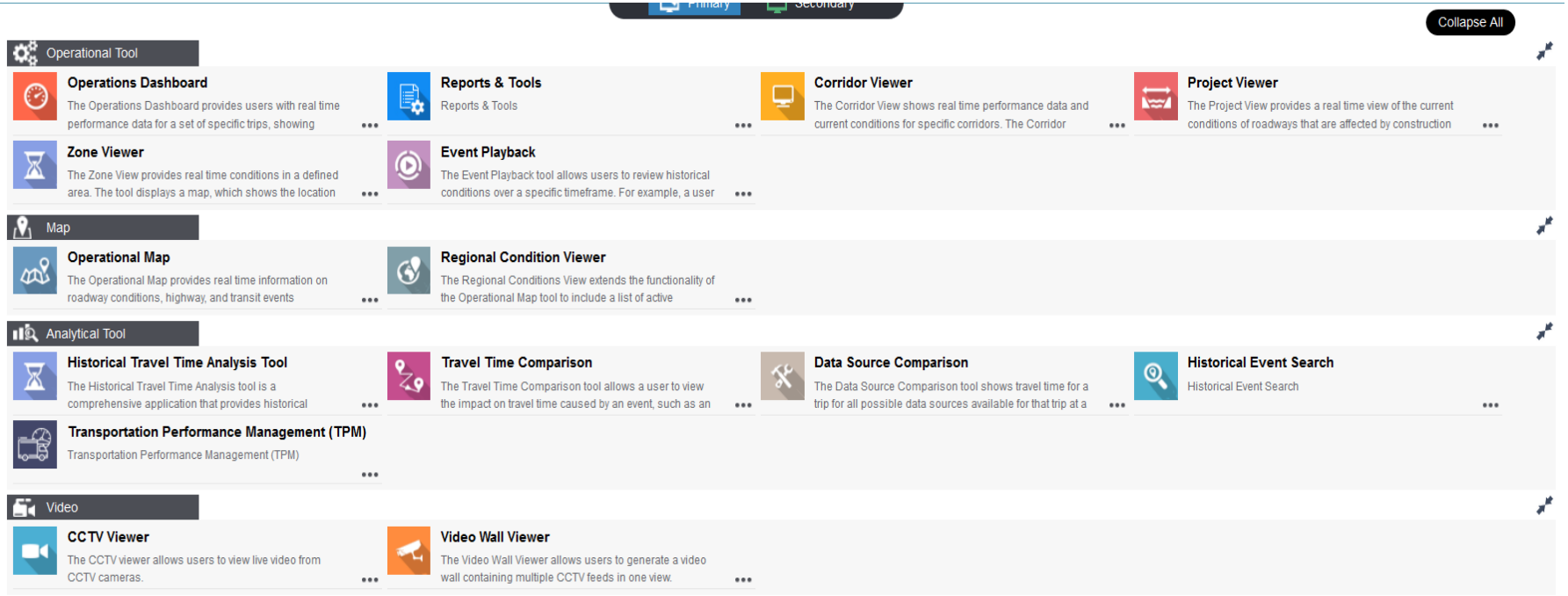
- October 2012 – 12 million gallons of corrosive water flooded the two tunnel tubes
  - Need to replace the tunnel electrical system, monitoring and control systems, and the drainage and fire standpipe system.
  - Contractors are also performing tunnel civil and structural improvements;
  - Installing new LED lights and emergency way-finding safety lights;
  - Replacing tunnel wall tiles, ceiling finishes, curbs and gutters, catwalks and duct banks, and repaving tunnel roadways.
  - General work schedule: (1 tube closed; 2 way traffic in open tube – trucks banned)
  - Monday thru Thursday 9pm to 6am
  - 10pm Friday's thru 5am Monday's

Pre-Construction

QMT 1 LANE OPEN
10PM FRI-5AM MON
EXPECT MAJOR DELAYS

QMT 1 LANE OPEN
10PM FRI-5AM MON
TRUCKS BANNED

Monitoring Tools



TRANSCOM Data Fusion Engine (DFE)

DFE System

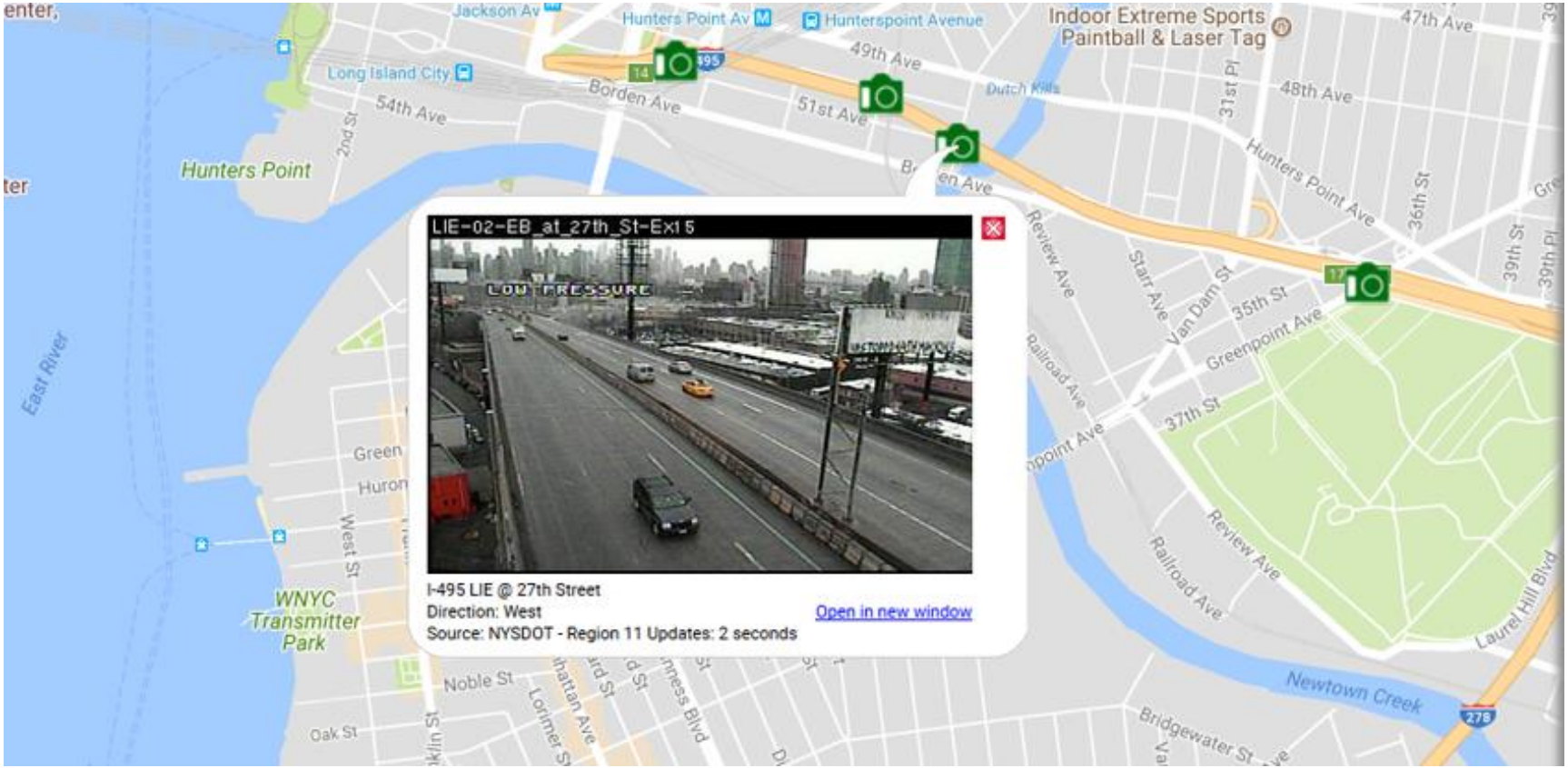
- **CCTVs – nearly 3k**
  - **Viewable on map**
  - Standalone viewer
  - Videowall
- **VMS**
  - **Can see real-time messages from NY State DOT, NY State Thruway, CT DOT (more to come)**
- **Includes real-time** and historical - **Highway** AND transit related incidents, **active** AND planned **construction and special events** (Dec 2011-present)
  - **In a query-able list**
  - **On a map**
  - **OR combined**
- **SPATEL System (Travel Times) – (January 2014-present)**
  - **Tabular dashboard**
  - **Graphically on map**
  - **Variety of reports**
- Real-Time Transit Map
  - 3 Commuter Systems (MTA's Metro-North and Long Island Railroad; NJ Transit Rail)
  - MTA NYC Subway
  - NJ Transit Bus
  - MTA NYC Transit Bus (soon)
- Planning Tools
- Kitchen Sink (coming soon)

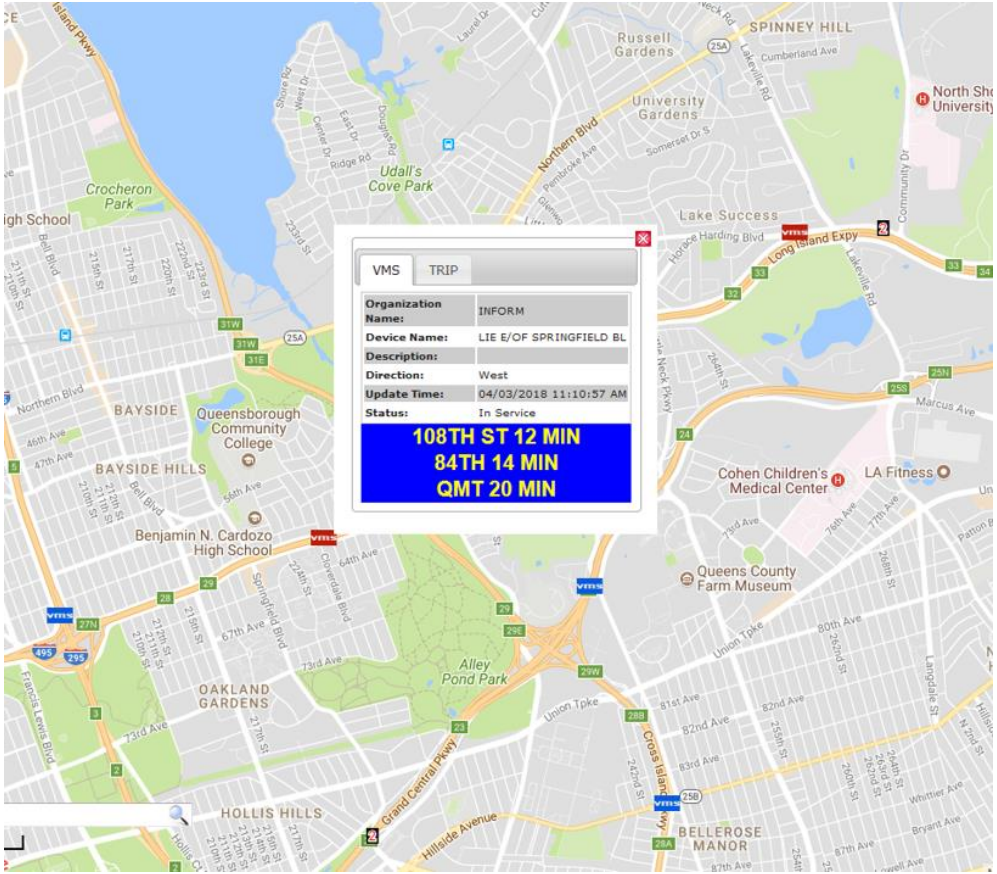
BOLD = Utilized feature during incident management

During Construction

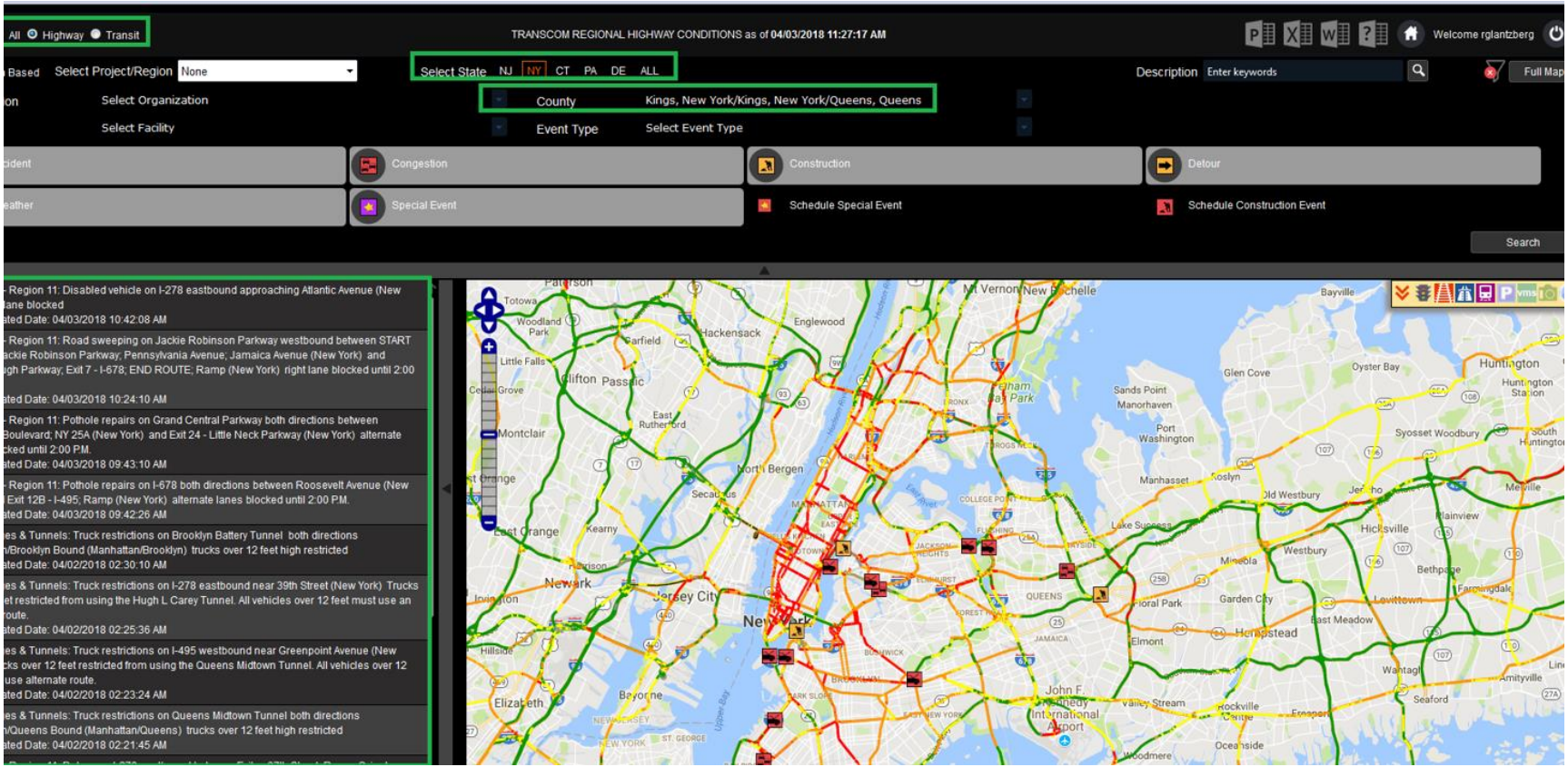
QMT 1 LANE OPEN
UNTIL 5AM MON
EXPECT MAJOR DELAYS

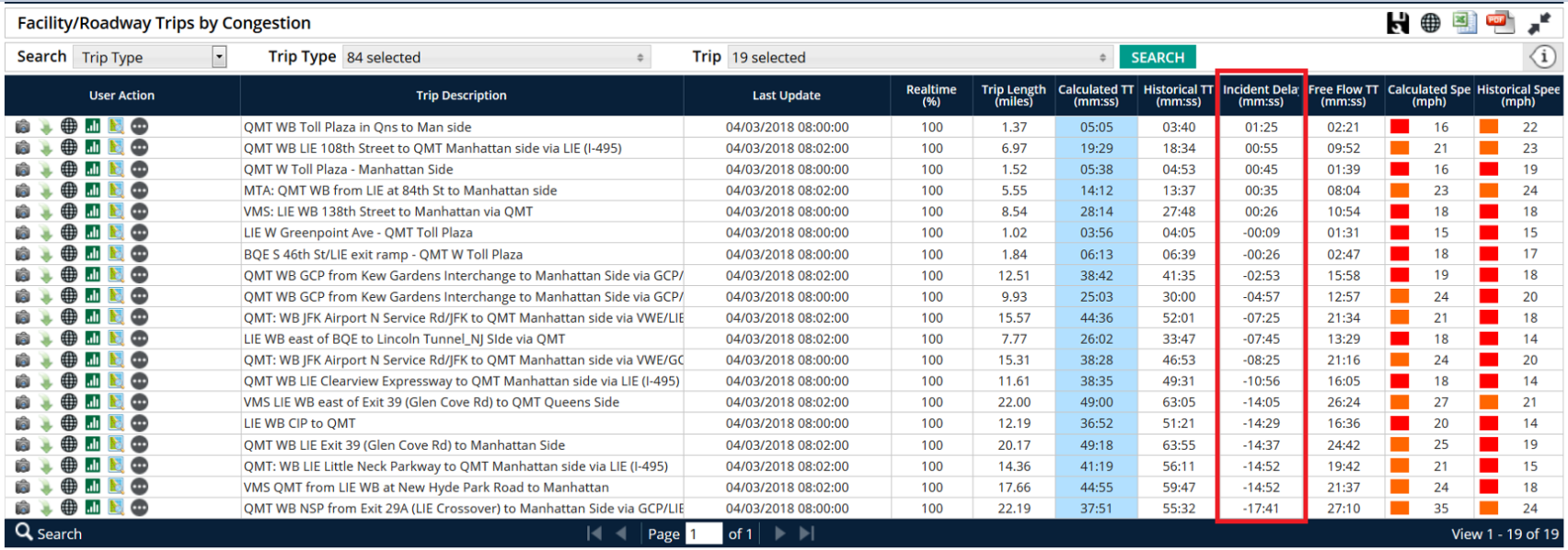
QMT 1 LANE OPEN
UNTIL 5AM MON
TRUCKS BANNED


LIE-02-EB_at_27th_St-Ex15
LOW PRESSURE
I-495 LIE @ 27th Street
Direction: West
Source: NYSDOT - Region 11 Updates: 2 seconds
Open in new window
Hunters Point
Long Island City
Jackson Av
Hunters Point Av
Hunterspoint Avenue
Indoor Extreme Sports
Paintball & Laser Tag
49th Ave
51st Ave
Borden Ave
54th Ave
47th Ave
48th Ave
Hunters Point Ave
Dutch Kills
31st Pl
36th St
39th St
Review Ave
Starr Ave
Van Dam St
35th St
Greenpoint Ave
37th St
Railroad Ave
East River
WNYC
Transmitter
Park
Green
Huron
West St
Noble St
Oak St
Newtown Creek
Bridgewater St
Laurel Hill Blvd



What's on the Boards?


All Highway Transit
TRANSCOM REGIONAL HIGHWAY CONDITIONS as of 04/03/2018 11:27:17 AM
Welcome rglantzberg
Select Project/Region None
Select State NJ NY CT PA DE ALL
Description Enter keywords
Full Map
Select Organization
County Kings, New York/Kings, New York/Queens, Queens
Select Facility
Event Type Select Event Type
Congestion
Construction
Detour
Special Event
Schedule Special Event
Schedule Construction Event
Search
Region 11: Disabled vehicle on I-278 eastbound approaching Atlantic Avenue (New
lane blocked
ated Date: 04/03/2018 10:42:08 AM
Region 11: Road sweeping on Jackie Robinson Parkway westbound between START
ackie Robinson Parkway; Pennsylvania Avenue; Jamaica Avenue (New York) and
gh Parkway; Exit 7 - I-678; END ROUTE; Ramp (New York) right lane blocked until 2:00
ated Date: 04/03/2018 10:24:10 AM
Region 11: Pothole repairs on Grand Central Parkway both directions between
Boulevard; NY 25A (New York) and Exit 24 - Little Neck Parkway (New York) alternate
cked until 2:00 P.M.
ated Date: 04/03/2018 09:43:10 AM
Region 11: Pothole repairs on I-678 both directions between Roosevelt Avenue (New
Exit 12B - I-495; Ramp (New York) alternate lanes blocked until 2:00 P.M.
ated Date: 04/03/2018 09:42:26 AM
es & Tunnels: Truck restrictions on Brooklyn Battery Tunnel both directions
n/Brooklyn Bound (Manhattan/Brooklyn) trucks over 12 feet high restricted
ated Date: 04/02/2018 02:30:10 AM
es & Tunnels: Truck restrictions on I-278 eastbound near 39th Street (New York) Trucks
et restricted from using the Hugh L Carey Tunnel. All vehicles over 12 feet must use an
route.
ated Date: 04/02/2018 02:25:36 AM
es & Tunnels: Truck restrictions on I-495 westbound near Greenpoint Avenue (New
cks over 12 feet restricted from using the Queens Midtown Tunnel. All vehicles over 12
use alternate route.
ated Date: 04/02/2018 02:23:24 AM
es & Tunnels: Truck restrictions on Queens Midtown Tunnel both directions
n/Queens Bound (Manhattan/Queens) trucks over 12 feet high restricted
ated Date: 04/02/2018 02:21:45 AM



Facility/Roadway Trips by Congestion

Search: Trip Type | Trip Type: 84 selected | Trip: 19 selected | SEARCH

User Action	Trip Description	Last Update	Realtime (%)	Trip Length (miles)	Calculated TT (mm:ss)	Historical TT (mm:ss)	Incident Dela (mm:ss)	Free Flow TT (mm:ss)	Calculated Spe (mph)	Historical Spee (mph)
	QMT WB Toll Plaza in Qns to Man side	04/03/2018 08:00:00	100	1.37	05:05	03:40	01:25	02:21	16	22
	QMT WB LIE 108th Street to QMT Manhattan side via LIE (I-495)	04/03/2018 08:02:00	100	6.97	19:29	18:34	00:55	09:52	21	23
	QMT W Toll Plaza - Manhattan Side	04/03/2018 08:00:00	100	1.52	05:38	04:53	00:45	01:39	16	19
	MTA: QMT WB from LIE at 84th St to Manhattan side	04/03/2018 08:02:00	100	5.55	14:12	13:37	00:35	08:04	23	24
	VMS: LIE WB 138th Street to Manhattan via QMT	04/03/2018 08:00:00	100	8.54	28:14	27:48	00:26	10:54	18	18
	LIE W Greenpoint Ave - QMT Toll Plaza	04/03/2018 08:00:00	100	1.02	03:56	04:05	-00:09	01:31	15	15
	BQE S 46th St/LIE exit ramp - QMT W Toll Plaza	04/03/2018 08:00:00	100	1.84	06:13	06:39	-00:26	02:47	18	17
	QMT WB GCP from Kew Gardens Interchange to Manhattan Side via GCP/	04/03/2018 08:02:00	100	12.51	38:42	41:35	-02:53	15:58	19	18
	QMT WB GCP from Kew Gardens Interchange to Manhattan Side via GCP/	04/03/2018 08:00:00	100	9.93	25:03	30:00	-04:57	12:57	24	20
	QMT: WB JFK Airport N Service Rd/JFK to QMT Manhattan side via VWE/LIE	04/03/2018 08:02:00	100	15.57	44:36	52:01	-07:25	21:34	21	18
	LIE WB east of BQE to Lincoln Tunnel_NJ SIde via QMT	04/03/2018 08:02:00	100	7.77	26:02	33:47	-07:45	13:29	18	14
	QMT: WB JFK Airport N Service Rd/JFK to QMT Manhattan side via VWE/GC	04/03/2018 08:00:00	100	15.31	38:28	46:53	-08:25	21:16	24	20
	QMT WB LIE Clearview Expressway to QMT Manhattan side via LIE (I-495)	04/03/2018 08:00:00	100	11.61	38:35	49:31	-10:56	16:05	18	14
	VMS LIE WB east of Exit 39 (Glen Cove Rd) to QMT Queens Side	04/03/2018 08:02:00	100	22.00	49:00	63:05	-14:05	26:24	27	21
	LIE WB CIP to QMT	04/03/2018 08:00:00	100	12.19	36:52	51:21	-14:29	16:36	20	14
	QMT WB LIE Exit 39 (Glen Cove Rd) to Manhattan Side	04/03/2018 08:02:00	100	20.17	49:18	63:55	-14:37	24:42	25	19
	QMT: WB LIE Little Neck Parkway to QMT Manhattan side via LIE (I-495)	04/03/2018 08:02:00	100	14.36	41:19	56:11	-14:52	19:42	21	15
	VMS QMT from LIE WB at New Hyde Park Road to Manhattan	04/03/2018 08:02:00	100	17.66	44:55	59:47	-14:52	21:37	24	18
	QMT WB NSP from Exit 29A (LIE Crossover) to Manhattan Side via GCP/LIE	04/03/2018 08:00:00	100	22.19	37:51	55:32	-17:41	27:10	35	24

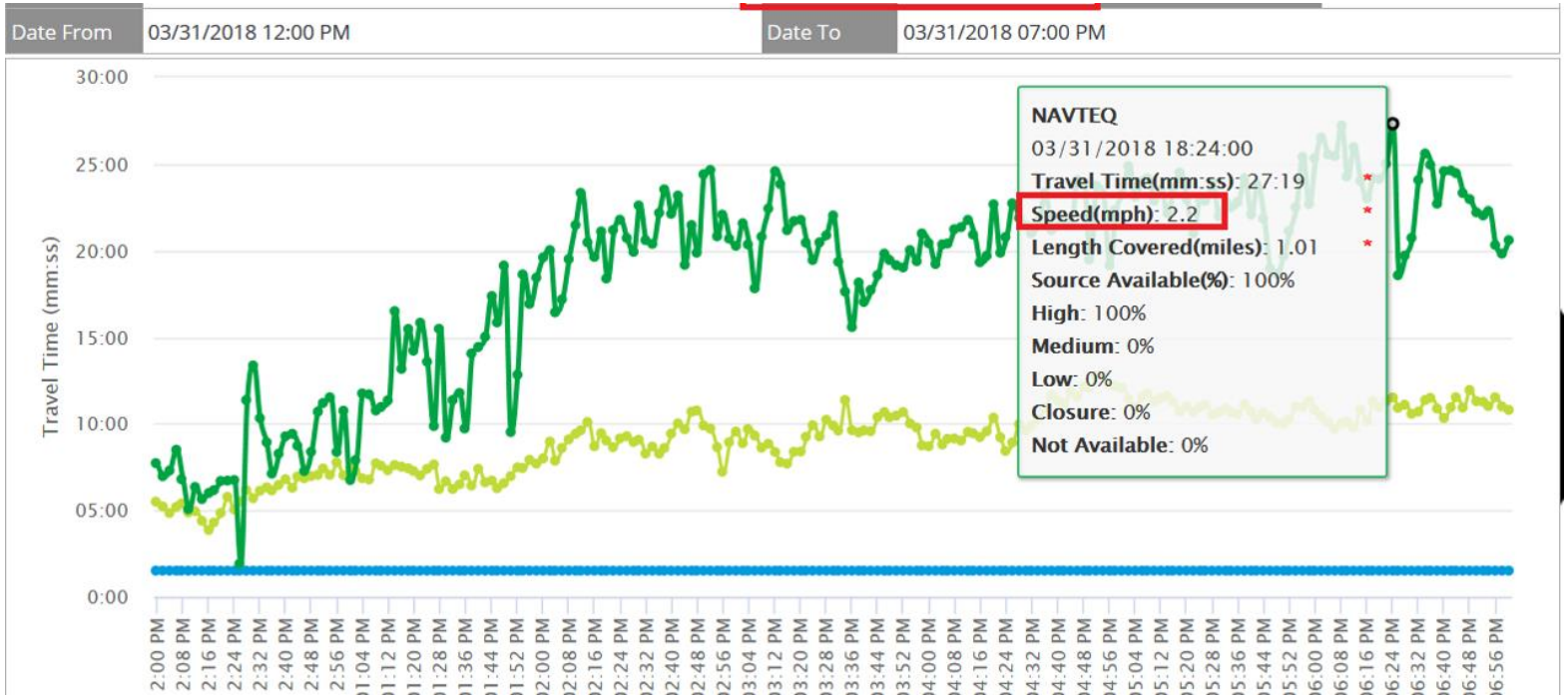
Search | Page 1 of 1 | View 1 - 19 of 19

The Dashboard

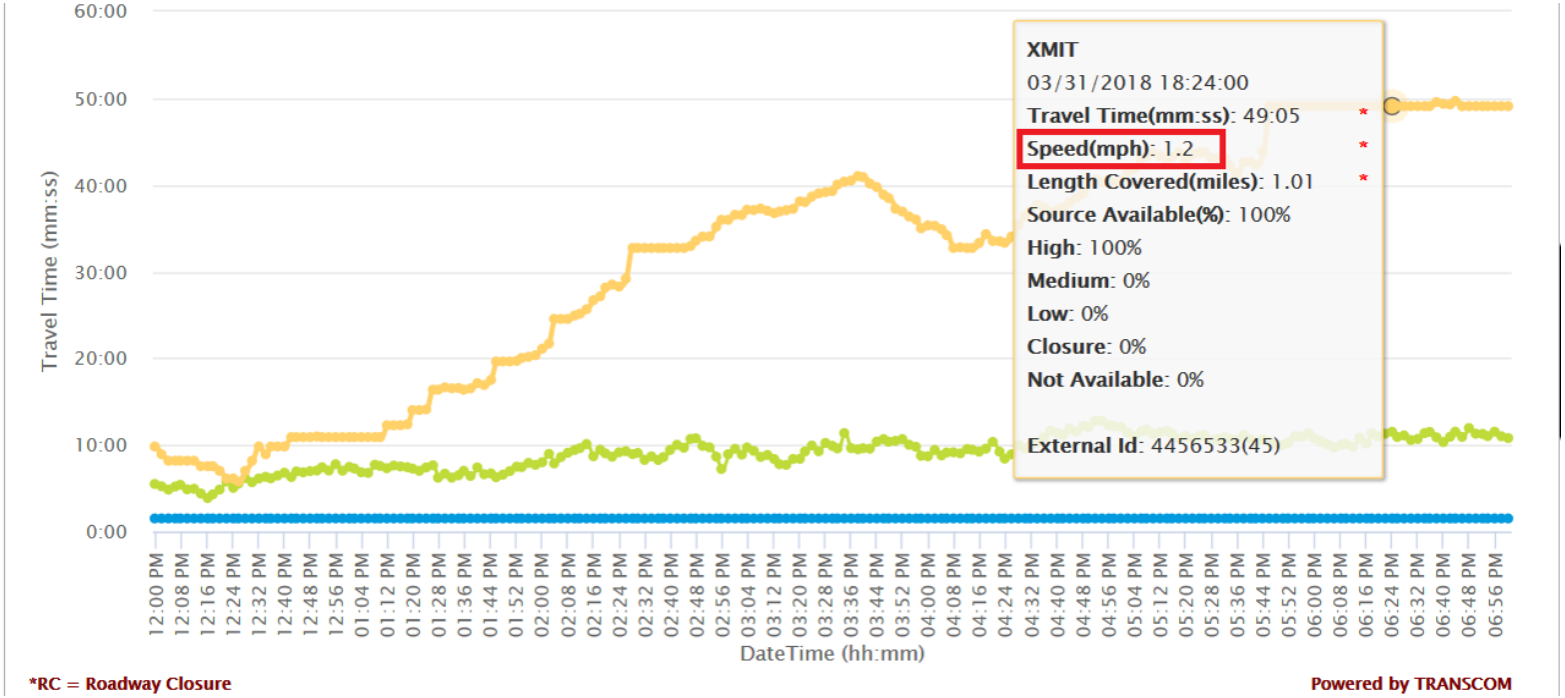
A 1 Mile Trip at …..

Mph	Time (Minutes)
7	8.571428571
6	10
5	12
4	15
3	20
2	30
1	60

2.2 mph for 1 mile trip = 27 minutes



1.2 mph for 1 mile trip = 49 minutes



When there are Significant Delays ….

QMT 1 LANE OPEN
USE ALTERNATE ROUTE
MAJOR DELAYS

QMT 1 LANE OPEN
TRUCKS BANNED
MAJOR DELAYS

Work in the North Tube is largely completed, while restoration in the South Tube is well underway. This project is scheduled for completion in 2018.

IMPROVING WORK ZONE SAFETY AND MOBILITY

Nikola Ivanov
University of Maryland CATT Lab

Work Zone Performance Monitoring

Improving Work Zone Safety and Mobility

CATT LABORATORY
www.cattlab.umd.edu

Work Zone Performance Monitoring

Motivation

Compliance with Final Rule on Work Zone Safety and Mobility

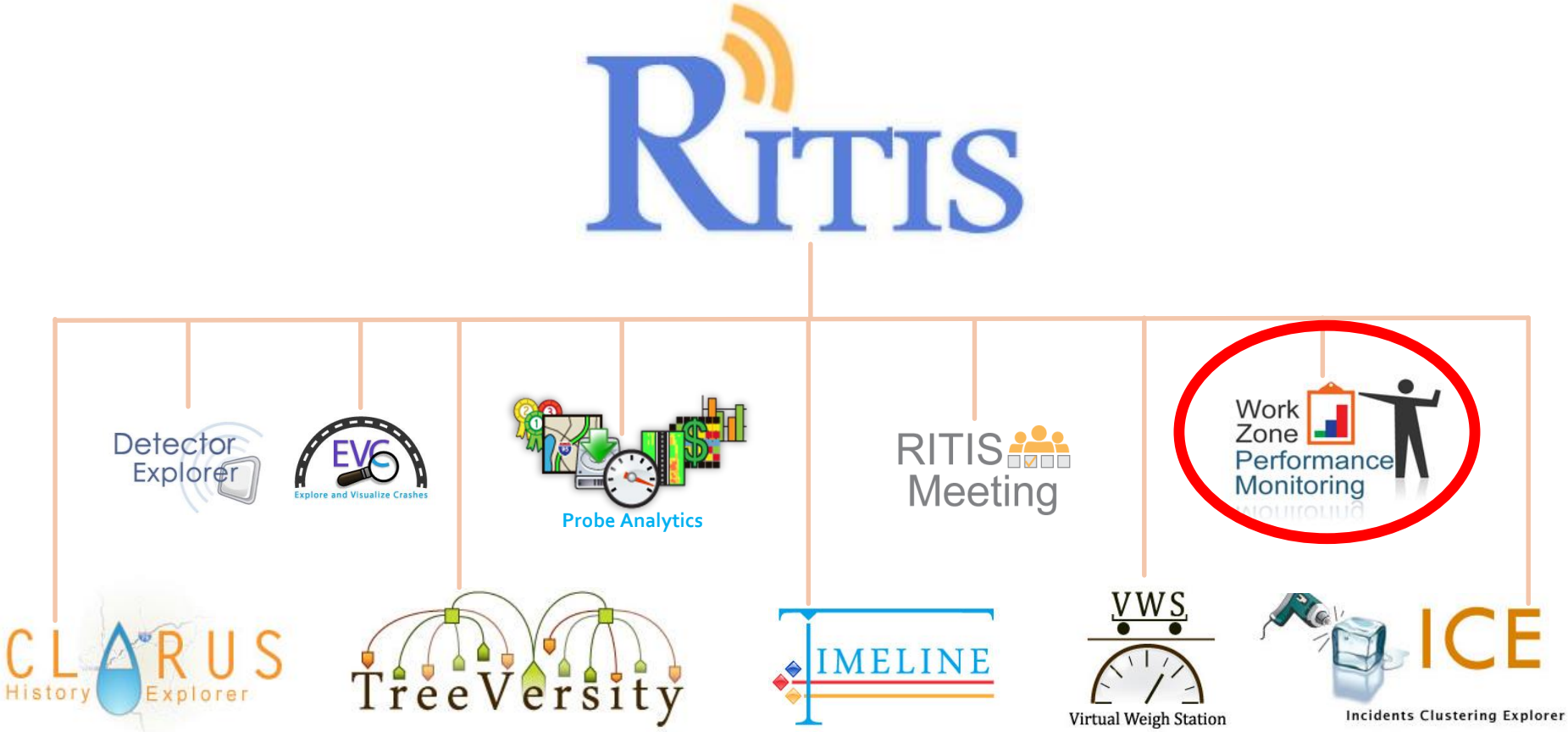
Funding

In 2013 MD SHA and FHWA funded a project to develop a real time performance monitoring tool for work zones using INRIX probe vehicle data and event data.

SHA State Highway Administration

U.S. Department of Transportation Federal Highway Administration

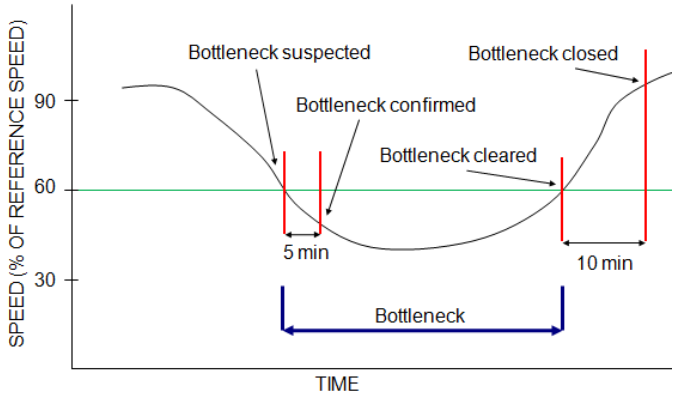
Context


RITIS
Detector Explorer
EVC
Explore and Visualize Crashes
Probe Analytics
RITIS Meeting
Work Zone Performance Monitoring
CLARUS
History Explorer
TreeVersity
IMELINE
VWS
Virtual Weigh Station
ICE
Incidents Clustering Explorer

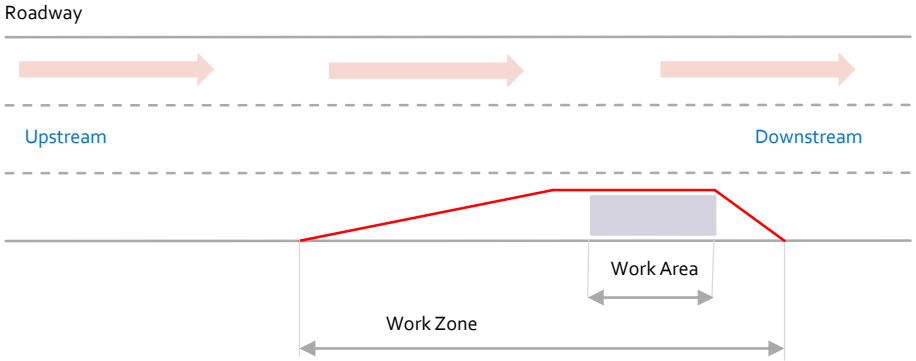
Data Sources and Key Definitions

- Active work zone information provided by SHA CHART system in real-time.
- Probe vehicle speed information from INRIX.

Queue/Bottleneck



Work Zone



User Delay Cost (UDC)

	12AM - 4AM	4AM - 8AM	8AM - 12PM	12PM - 4PM	4PM - 8PM	8PM - 12AM	Daily Totals
Tue 5/06/2014	$3.08	$108.81	$7,128.14	$27.44	$65.90	$18.84	$7,352.21
Wed 5/07/2014	$4.96	$109.18	$8,340.98	$1,363.86	$69.40	$22.46	$9,910.84
Thu 5/08/2014	$14.66	$25.33	$3,590.53	$3,622.06	$110.97	$80.95	$7,444.50
Fri 5/09/2014	$3.96	$19.39	$617.81	$16.48	$2,440.87	$6.42	$3,104.93
Sat 5/10/2014	$4.07	$0.49	$0.00	$36.27	$12.90	$54.81	$108.54
Sun 5/11/2014	$4.41	$10.43	$0.00	$4,314.89	$0.00	$6.63	$4,336.36
Mon 5/12/2014	$2.58	$201.15	$8,183.06	$3,144.59	$349.59	$27.50	$11,908.47
Hourly Totals	$37.72	$474.78	$27,860.52	$12,525.59	$3,049.63	$217.61	Grand Total: $46,165.85

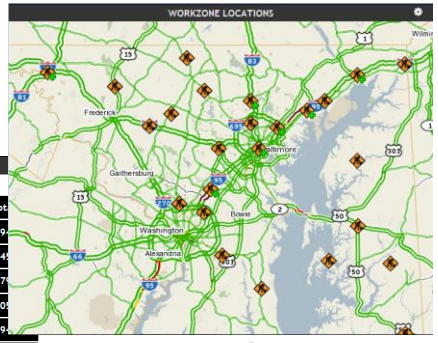
Weekend Lowest Highest No Data

Calculated using:

- ADT (AADT with adjustment factor)
- Passenger/commercial vehicle percentages
- Speed reduction factor
- Delay

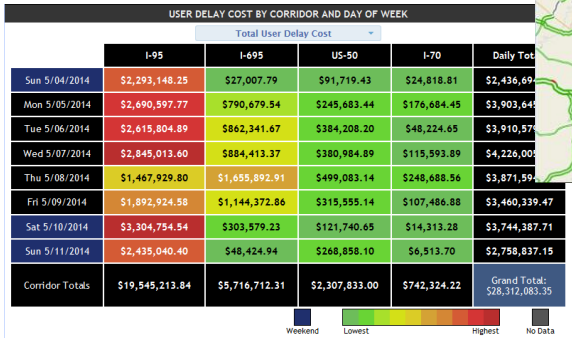
Audience and Goals

- **Audience**: Project Engineers and Managers
- **Goals**:
  - Real time performance
  - Alerts when thresholds exceeded
  - Potential actions based on identified performance



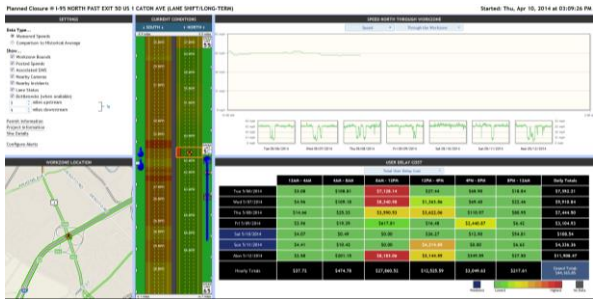
Regional performance

- **Audience**: Public Relations
- **Goals**:
  - Real time and historical performance
  - Responding to complaints and inquiries



Corridor performance

- **Audience**: Planners and Decision Makers
- **Goals**:
  - Closure costs
  - Review of previous performance



Individual work zone performance

Work Zone Dashboard

Work Zone Performance Monitoring

Work Zone Dashboard Beta INRIX

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CURRENT WORK ZONES

REGION/EVENT	# OF NEARBY INCIDENTS	QUEUE LENGTH (MI)	USER DELAY COST ($)
Florida (28)	1299	0	$0
Maryland (187)	432	6	$1.1M
Massachusetts (3)	1	0	$0
Essex (1)	0	0	$0
I-95 south	-	0	-
Middlesex (1)	0	0	$0
I-95 north	-	0	-
Norfolk (1)	1	0	$0
I-95 north	1	0	-
New York (1[illegible])	2541	12.1	$17.4M
North Carolina (63)	191	0	$[illegible]
Pennsylvania (207)	1272	1.4	$3[illegible]
South Carolina (6)	3	0	$2.9K
Clarendon (1)	3	0	$412
I95 BETWEEN MM 121 AND ...	3	0	$412
Lexington (1)	0	0	$0
I26 BETWEEN MM 91 (S[illegible]	-	0	-
Richland (4)	0	0	$2.5K
I77 BETWEEN MM 15A (Perci...	-	0	$2.1K
I77 BETWEEN MM 15B (SC 1...	-	0	$295
I77 BETWEEN MM 22 (Killian...	-	0	$13
I77 BETWEEN MM 6B (SC 76...	-	0	$27
Virginia (879)	10437	26	$15.0M
Accomack (6)	42	0	$17.5K
US-13N north @ MM 128.500	7	0	$2.9K
US-13N north @ MM 128.500	7	0	$2.9K
US-13N north @ MM 124.600	7	0	$2.9K
US-13N north @ MM 124.600	7	0	$2.9K

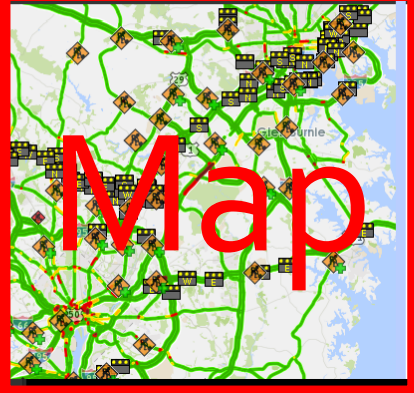
Overview

List

TOP CRITICAL WORK ZONES

SEVERITY/EVENT	LANE STATUS	QUEUE LENGTH (MI)	USER DELAY COST ($)
Critical (8)		23	$2.0M
MD 545 SOUTH BETWEEN DOGWOOD RD AND ELKTON RD		3.3	$4.8K
New York City Area		3	$1.9M
New York City Area		2.7	$8.8K
VA-267E east @ MM 22.600		2.8	$14.8K
VA-267E east @ MM 22.600		2.8	$14.8K
VA-267E east @ MM 22.600		2.8	$14.8K
VA-267E east @ MM 22.600		2.8	$14.8K
VA-267E east @ MM 22.600		2.8	$14.8K
Major (7)		11.9	$1.9M
MD 372 EAST BETWEEN ELM RIDGE AVE AND MAIDEN CHOICE LA		1.6	$2.9K
New Jersey Statewide		1.3	$65.8K
New Jersey Statewide		1.4	$1.5K
I-395R north @ MM 5.500		1.9	$0.5M

Critical



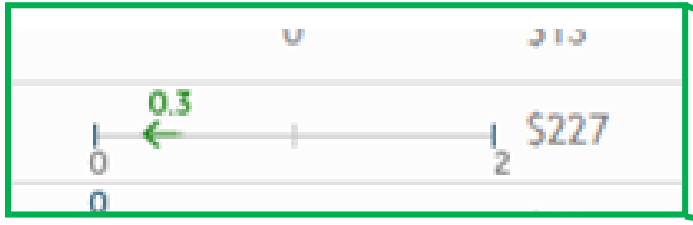
Total User Delay Cost

	I-78 (PA)	I-695 (MD)	I-95 (MD)	I-95 (NH)	Daily Totals
Mon 4/02	$25.9K	$248.6K	$92.8K	$0.9K	$368.3K
Tue 4/03	$291.9K	$756.6K	$387.1K	$1.1K	$1.4M
Wed 4/04	$14.8K	$434.4K	$191.3K	$0.4K	$640.9K
Thu 4/05	$[illegible].1K	$332.7K	$273.6K	$0.5K	$659.8K
Fri 4/06	$[illegible].2K	$[illegible]	$216.[illegible]	[illegible].4K	$1.1M
Sat 4/07	$[illegible].2K	$[illegible]	$[illegible]	$1.0K	$86.9K
Sun 4/08	[illegible]	[illegible]	[illegible]	$0.9K	$450.5K
Mon 4/09	$376.4K	$263.8K	$150.6K	$48.9K	$839.7K
Corridor Totals	$1.1M	$2.7M	$1.7M	$55.1K	Grand Total: $5.6M

Weekend Lowest Highest No Data

Delay

Overview List



Cecil (12)	60	3.3	$31.4K
CECIL COUNTY: MD-7 NORT...	-	0	$82
I-95 NORTH FROM MP 92.99...	51		$13.2K
I-95 SOUTH FROM MP 93.25...	-		$4.5K
CECIL COUNTY: I-95 NORTH...	1		-
MD 545 SOUTH BETWEEN D...	1	3.3	$4.8K
CECIL COUNTY: US-40 EAST...	-		
CECIL COUNTY: US-40 WEST...	-	0	$1.8K
MD 274 SOUTH FROM POST ...	-		$326
CECIL COUNTY: MD-273 WE...	-	0	$187
CECIL COUNTY: MD-272 NO...	-	0	$193
CECIL COUNTY: MD-316 NO...	-		$1.4K
I-95 SOUTH PAST EXIT 109B ...	7	0	$125
Charles (6)	3	0	$5.1K
Frederick (8)	3	0.3	$2.6K
FREDERICK COUNTY: MD-19...	-		$440
FREDERICK COUNTY: MD-75 ...	1		$479
FREDERICK COUNTY: US-15 ...	1	0	$1
FREDERICK COUNTY: I-270 ...	-	0	-
FREDERICK COUNTY: US-40 ...		0	$1.4K
FREDERICK COUNTY: MD-77 ...	-	0	$13
FREDERICK COUNTY: US-40 ...	-	0.3	$227
FREDERICK COUNTY: MD-14...	1		
Harford (16)	28	0	$12.1K
MD 152 WEST FROM PULASK...	-		$2.5K

Work Zone Dashboard

Work Zone Performance Monitoring

Work Zone Dashboard Beta INRIX

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I95 BETWEEN MM 121 AND ...	3	0	$412
Lexington (1)	0	0	$0
I26 BETWEEN MM 91 (SC48 ...	-	0	-
Richland (4)	0	0	$2.5K
I77 BETWEEN MM 15A (Perci...	-	0	$2.1K
I77 BETWEEN MM 15B (SC 1...	-	0	$295
I77 BETWEEN MM 22 (Killian...	-	0	$13
I77 BETWEEN MM 6B (SC 76...	-	0	$27
Virginia (879)	10437	26	$15.0M
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US-13N north @ MM 124.600	7	0	$2.9K
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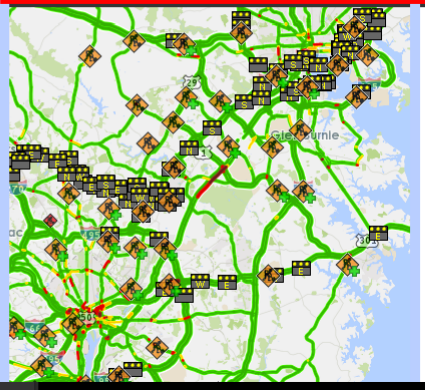
Major (7)		11.9	$1.9M
MD 372 EAST BETWEEN ELM RIDGE AVE AND MAIDEN CHOICE LA		1.6	$2.9K
New Jersey Statewide		1.3	$65.8K
New Jersey Statewide		1.4	$1.5K
I-395R north @ MM 5.500		1.9	$0.5M



Total User Delay Cost

	I-78 (PA)	I-695 (MD)	I-95 (MD)	I-95 (NH)	Daily Totals
Mon 4/02	$25.9K	$248.6K	$92.8K	$0.9K	$368.3K
Tue 4/03	$291.9K	$756.6K	$387.1K	$1.1K	$1.4M
Wed 4/04	$14.8K	$434.4K	$191.3K	$0.4K	$640.9K
Thu 4/05	$53.1K	$332.7K	$273.6K	$0.5K	$659.8K
Fri 4/06	$351.2K	$534.5K	$216.5K	$1.4K	$1.1M
Sat 4/07	$22.2K	$36.8K	$26.9K	$1.0K	$86.9K
Sun 4/08	$5.3K	$71.8K	$372.4K	$0.9K	$450.5K
Mon 4/09	$376.4K	$263.8K	$150.6K	$48.9K	$839.7K
Corridor Totals	$1.1M	$2.7M	$1.7M	$55.1K	Grand Total: $5.6M

Weekend | Lowest | Highest | No Data

Critical Work Zones

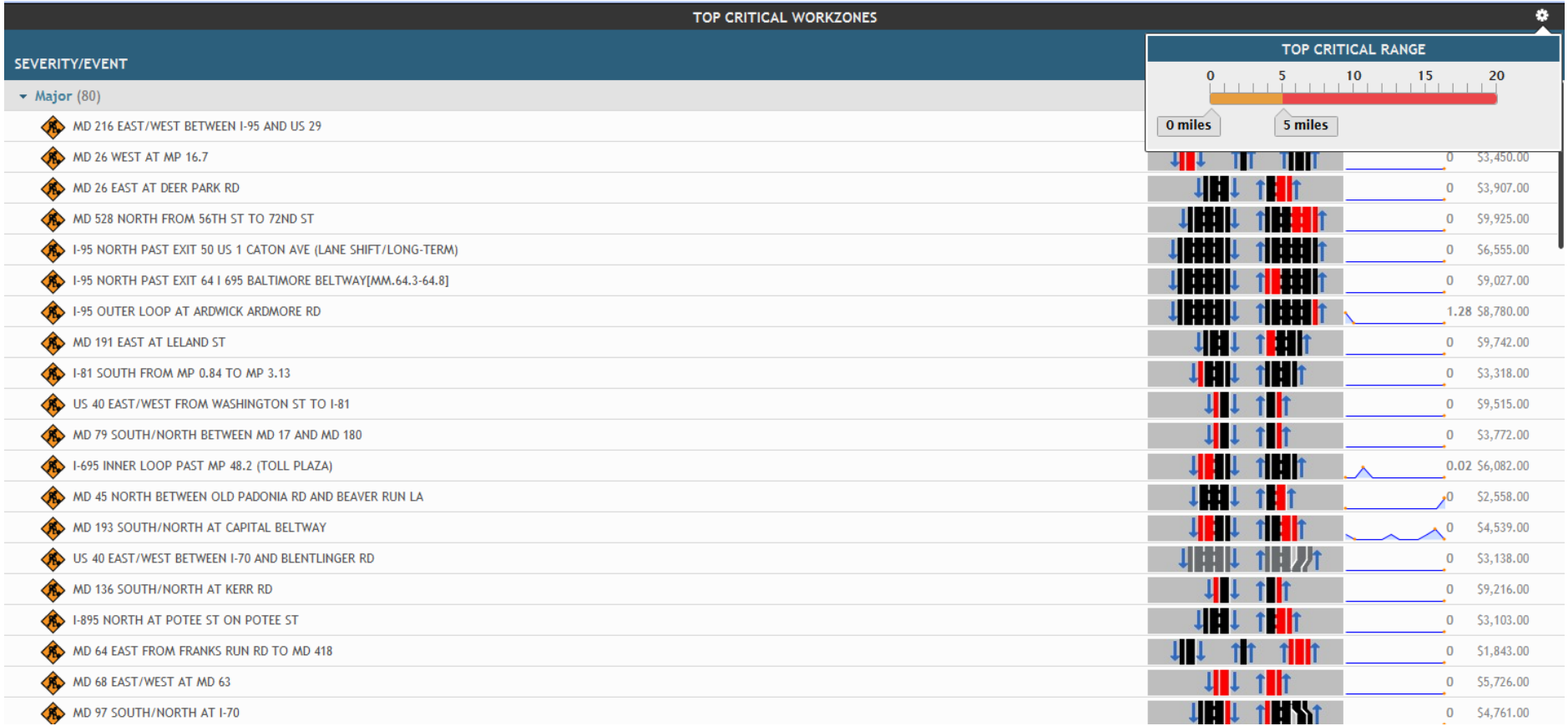
Work Zone Performance Monitoring

TOP CRITICAL WORKZONES

SEVERITY/EVENT	LANE STATUS	QUEUE LENGTH (MI)	USER DELAY COST ($)
Critical (1)		2.35	$7,781.00
I-695 INNER LOOP BETWEEN EXIT 12 MD 372 WILKENS AVE AND EXIT 13 MD 144 FREDERICK RD		2.35	$7,781.00
Major (2)		2.51	$9,527.00
RIVERDALE RD WEST BETWEEN 67TH PL AND MD 410		1.01	$5,507.00
I-695 OUTER LOOP WEST OF EXIT 1 MD 173 HAWKINS POINT RD (CURTIS CREEK DRAWBRIDGE)		1.5	$4,020.00

Critical Work Zone Parameters

Work Zone Performance Monitoring



Work Zone Dashboard

Work Zone Performance Monitoring

Work Zone Dashboard Beta INRIX ▾

Welcome, Nikola Ivanov | Help | Logout

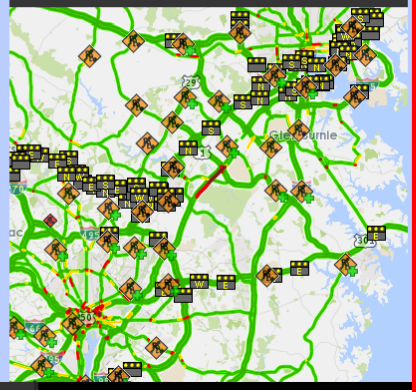
CURRENT WORK ZONES

REGION/EVENT	# OF NEARBY INCIDENTS	QUEUE LENGTH (MI)	USER DELAY COST ($)
Florida (28)	1299	0	$0
Maryland (187)	432	6	$1.1M
Massachusetts (3)	1	0	$0
Essex (1)	0	0	$0
I-95 south	-	0	-
Middlesex (1)	0	0	$0
I-95 north	-	0	-
Norfolk (1)	1	0	$0
I-95 north	1	0	-
New York (186)	2541	12.1	$17.4M
North Carolina (63)	191	0	$2.0K
Pennsylvania (207)	1272	1.4	$3.4M
South Carolina (6)	3	0	$2.9K
Clarendon (1)	3	0	$412
I95 BETWEEN MM 121 AND ...	3	0	$412
Lexington (1)	0	0	$0
I26 BETWEEN MM 91 (SC48 ...	-	0	-
Richland (4)	0	0	$2.5K
I77 BETWEEN MM 15A (Perci...	-	0	$2.1K
I77 BETWEEN MM 15B (SC 1...	-	0	$295
I77 BETWEEN MM 22 (Killian...	-	0	$13
I77 BETWEEN MM 6B (SC 76...	-	0	$27
Virginia (879)	10437	26	$15.0M
Accomack (6)	42	0	$17.5K
US-13N north @ MM 128.500	7	0	$2.9K
US-13N north @ MM 128.500	7	0	$2.9K
US-13N north @ MM 124.600	7	0	$2.9K
US-13N north @ MM 124.600	7	0	$2.9K

TOP CRITICAL WORK ZONES

SEVERITY/EVENT	LANE STATUS	QUEUE LENGTH (MI)	USER DELAY COST ($)
Critical (8)		23	$2.0M
MD 545 SOUTH BETWEEN DOGWOOD RD AND ELKTON RD		3.3	$4.8K
New York City Area		3	$1.9M
New York City Area		2.7	$8.8K
VA-267E east @ MM 22.600		2.8	$14.8K
VA-267E east @ MM 22.600		2.8	$14.8K
VA-267E east @ MM 22.600		2.8	$14.8K
VA-267E east @ MM 22.600		2.8	$14.8K
VA-267E east @ MM 22.600		2.8	$14.8K
Major (7)		11.9	$1.9M
MD 372 EAST BETWEEN ELM RIDGE AVE AND MAIDEN CHOICE LA		1.6	$2.9K
New Jersey Statewide		1.3	$65.8K
New Jersey Statewide		1.4	$1.5K
I-395R north @ MM 5.500		1.9	$0.5M

WORK ZONE LOCATIONS



USER DELAY COST BY CORRIDOR AND DAY OF WEEK

Total User Delay Cost

	I-78 (PA)	I-695 (MD)	I-95 (MD)	I-95 (NH)	Daily Totals
Mon 4/02	$25.9K	$248.6K	$92.8K	$0.9K	$368.3K
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Wed 4/04	$14.8K	$434.4K	$191.3K	$0.4K	$640.9K
Thu 4/05	$53.1K	$332.7K	$273.6K	$0.5K	$659.8K
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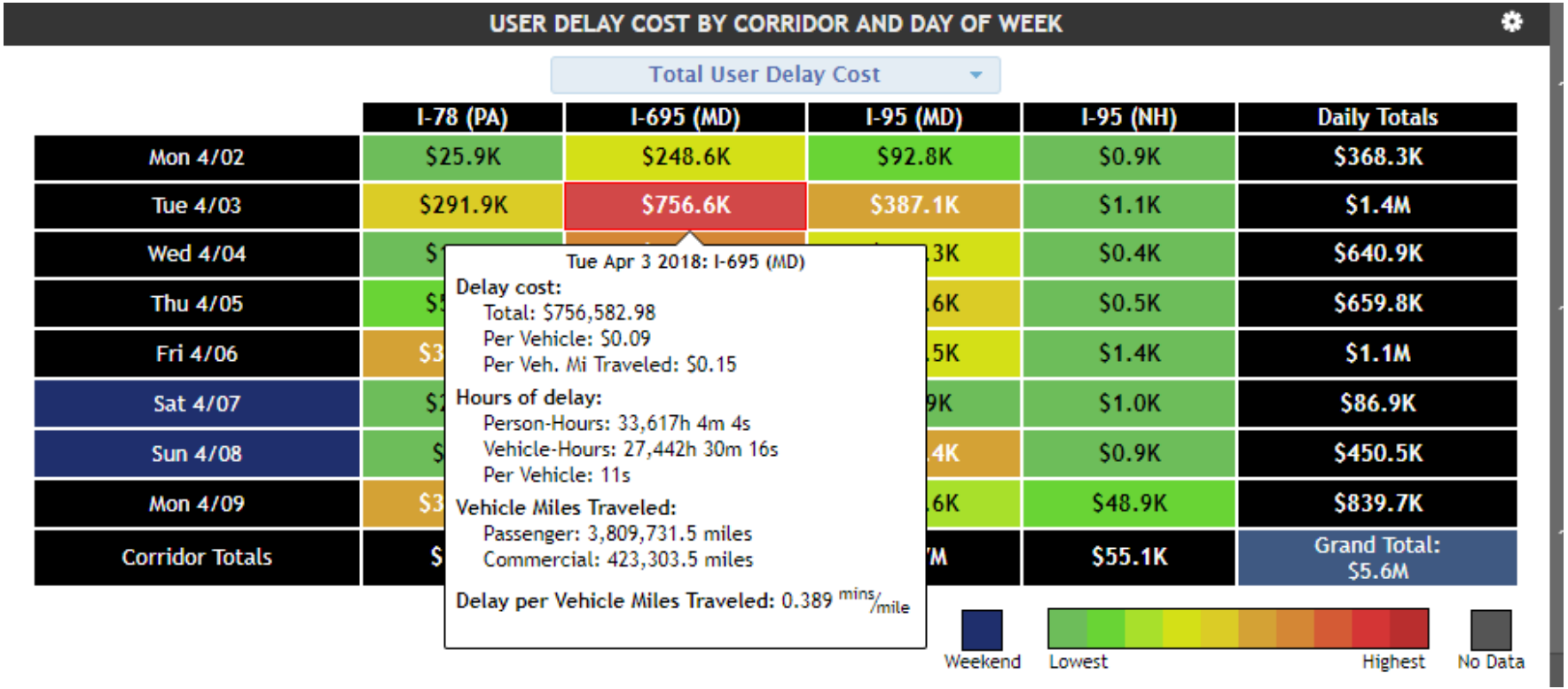
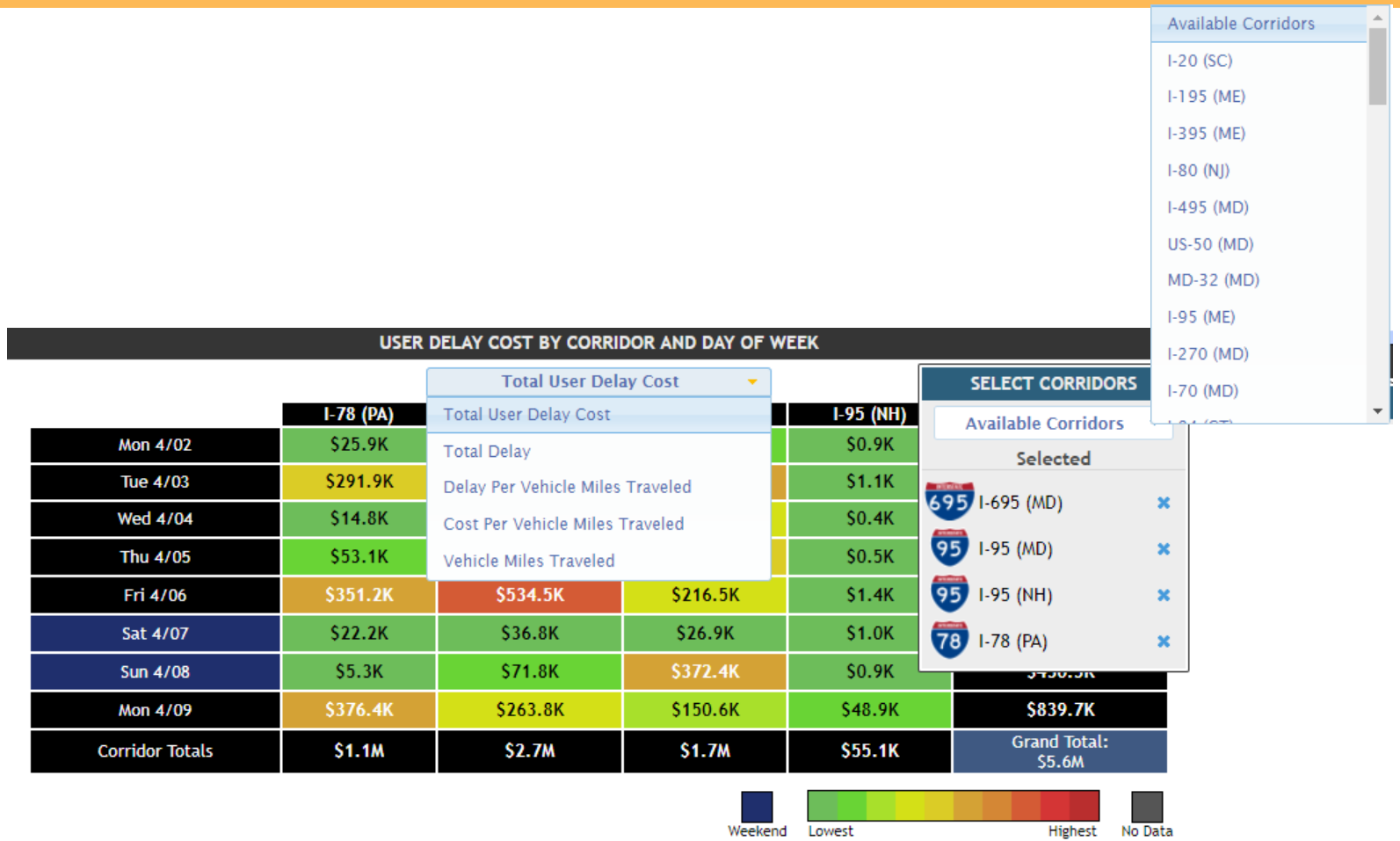
Mon 4/09	$376.4K	$263.8K	$150.6K	$48.9K	$839.7K
Corridor Totals	$1.1M	$2.7M	$1.7M	$55.1K	Grand Total: $5.6M

Weekend | Lowest | Highest | No Data

User Delay Cost Information



UDC Options and Corridor Selection



Work Zone Dashboard

Work Zone Performance Monitoring

Work Zone Dashboard Beta INRIX ▾

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CURRENT WORK ZONES

REGION/EVENT	# OF NEARBY INCIDENTS	QUEUE LENGTH (MI)	USER DELAY COST ($)
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I-95 north	1	0	-
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Lexington (1)	0	0	$0
I26 BETWEEN MM 91 (SC48 ...	-	0	-
Richland (4)	0	0	$2.5K
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TOP CRITICAL WORK ZONES

SEVERITY/EVENT	LANE STATUS	QUEUE LENGTH (MI)	USER DELAY COST ($)
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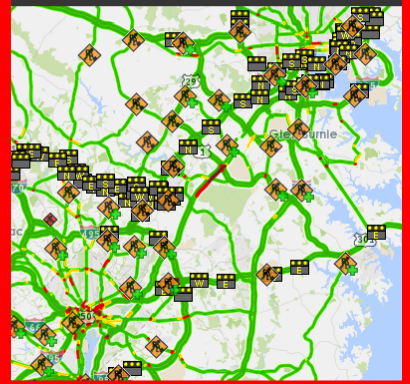
MD 372 EAST BETWEEN ELM RIDGE AVE AND MAIDEN CHOICE LA		1.6	$2.9K
New Jersey Statewide		1.3	$65.8K
New Jersey Statewide		1.4	$1.5K
I-395R north @ MM 5.500		1.9	$0.5M

WORK ZONE LOCATIONS



USER DELAY COST BY CORRIDOR AND DAY OF WEEK

Total User Delay Cost

	I-78 (PA)	I-695 (MD)	I-95 (MD)	I-95 (NH)	Daily Totals
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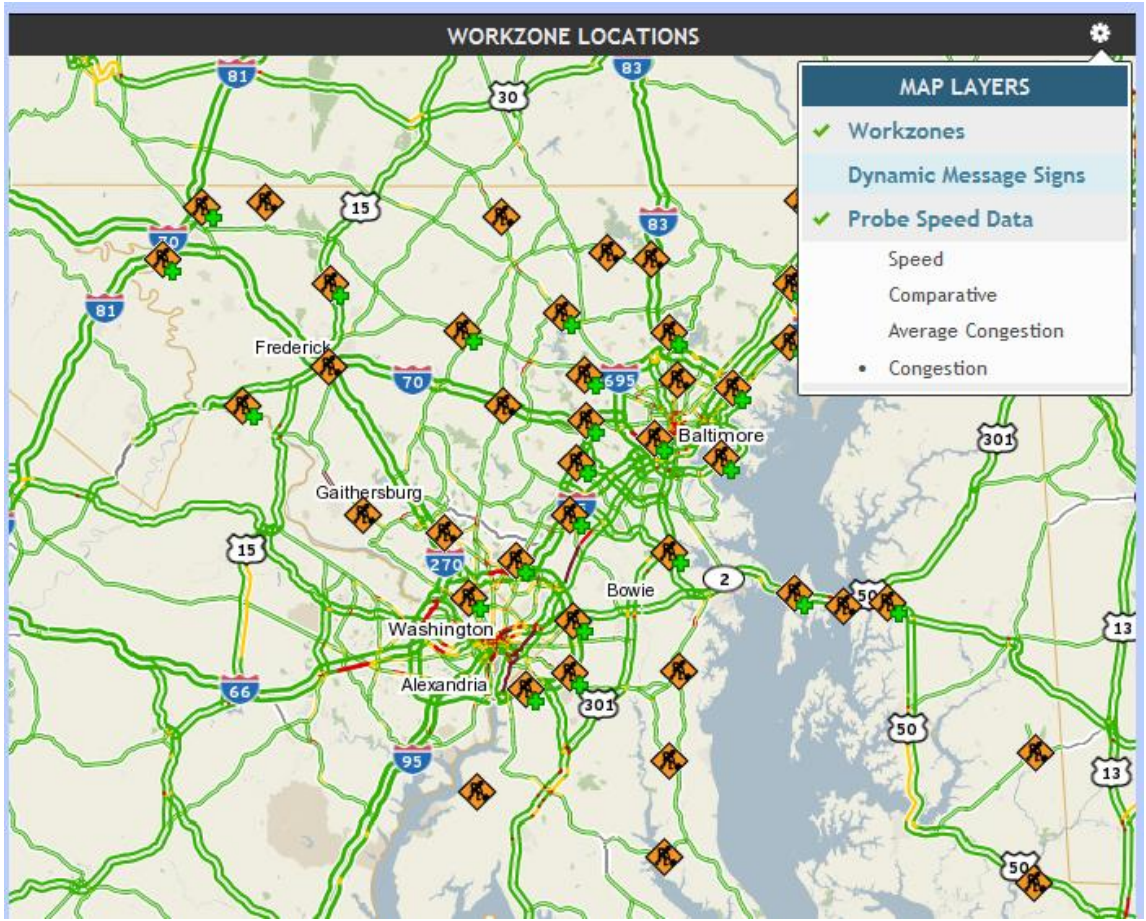
Corridor Totals	$1.1M	$2.7M	$1.7M	$55.1K	Grand Total: $5.6M

Weekend · Lowest · Highest · No Data

Map Layers and Options



Individual Work Zone Profile

Work Zone Performance Monitoring

Planned Closure @ I-695 INNER LOOP BETWEEN EXIT 12 MD 372 WILKENS AVE AND EXIT 13 MD 144 FREDERICK RD

Started: Thu, Apr 24, 2014 at 09:24:56 AM

Settings

SETTINGS

Data Type...
- Measured Speeds
- Comparison to Historical Average

Show...
- Work Zone Bounds
- Posted Speeds
- Associated DMS
- Nearby Cameras
- Nearby Incidents
- Lane Status
- Bottlenecks (when available)

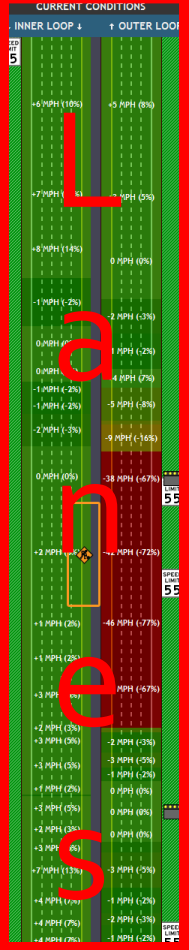
5 miles upstream

5 miles downstream

Permit Information
Project Information
Site Details
Configure Alerts

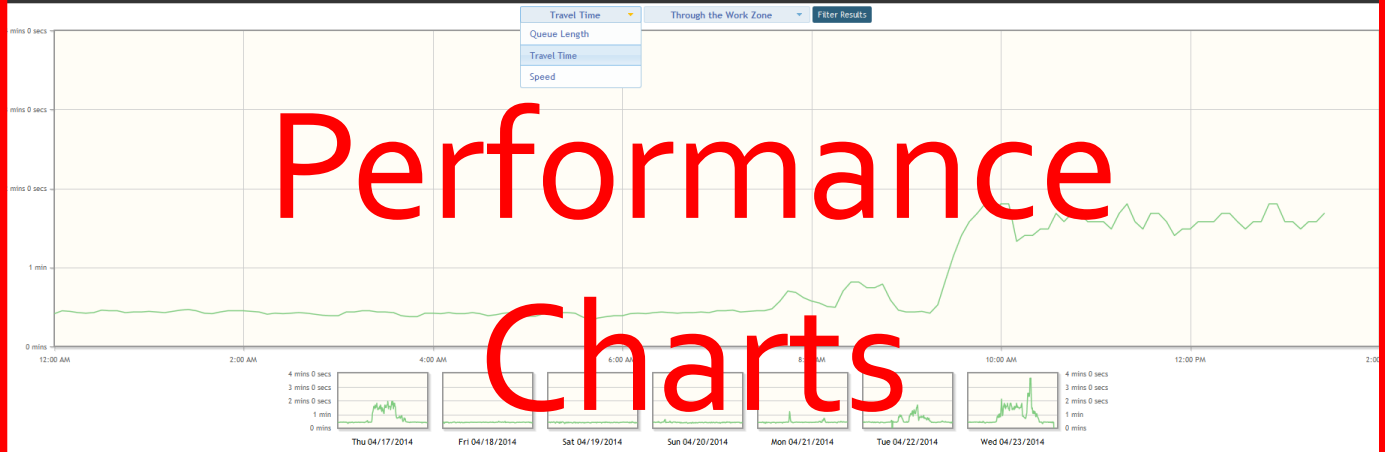
Lanes

CURRENT CONDITIONS



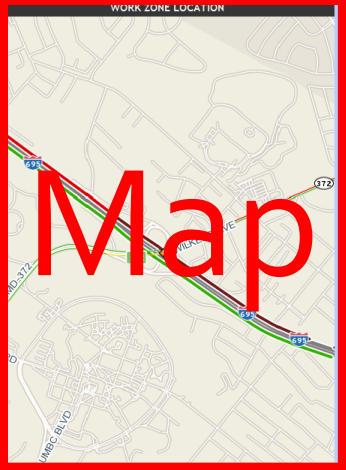
Performance Charts

TRAVEL TIME THROUGH WORKZONE ONLY



Map

WORK ZONE LOCATION



Delay

Total User Delay Cost

	12AM - 4AM	4AM - 8AM	8AM - 12PM	12PM - 4PM	4PM - 8PM	8PM - 12AM	Daily Totals
Thu 4/17/2014	$11.52	$183.00	$9,306.97	$16,405.23	$2,958.90	$67.58	$28,933.20
Fri 4/18/2014	$6.17	$29.46	$82.00	$221.35	$127.06	$50.00	$516.04
Sat 4/19/2014	$27.17	$7.65	$3.12	[illegible]	$17.28	$46.01	$123.66
Sun 4/20/2014	$39.81	$24.66	[illegible]	[illegible]	$26.78	$18.42	$115.80
Mon 4/21/2014	$2.46	$48.75	[illegible]	$103.[illegible]	$899.54	$131.35	$1,973.63
Tue 4/22/2014	$25.38	$264.46	$1,819.65	$8,771.39	$2,675.70	$189.00	$13,745.58
Wed 4/23/2014	$20.52	$477.24	$12,525.82	$13,993.07	$16,213.27	$80.23	$43,310.14
Hourly Totals	$133.04	$1,035.22	$24,525.89	$39,522.78	$22,918.53	$582.59	Grand Total: $88,718.06

Weekend | Lowest | Highest | No Data

Settings and Map

Planned Closure @ US 29 SOUTH AT INDUSTRIAL PKW

SETTINGS

Data Type...

- (•) Measured Speeds
- ( ) Comparison to Historical Average

Show...

- [x] Work Zone Bounds
- [x] Posted Speeds
- [x] Associated DMS
- [x] Nearby Cameras
- [x] Nearby Incidents
- [ ] Lane Status
- [x] Bottlenecks (when available)

5 miles upstream

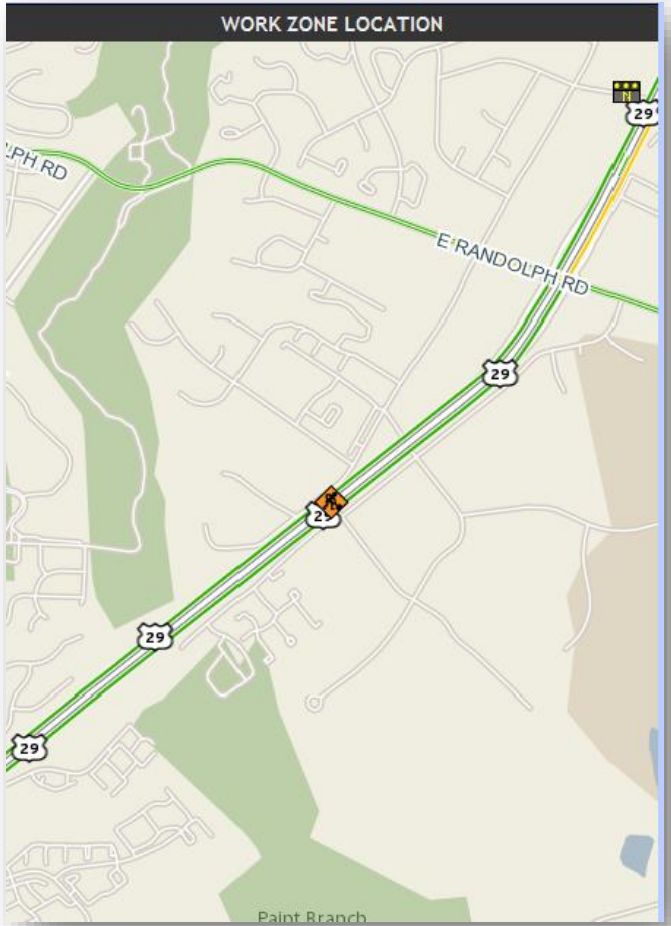
5 miles downstream

Permit Information

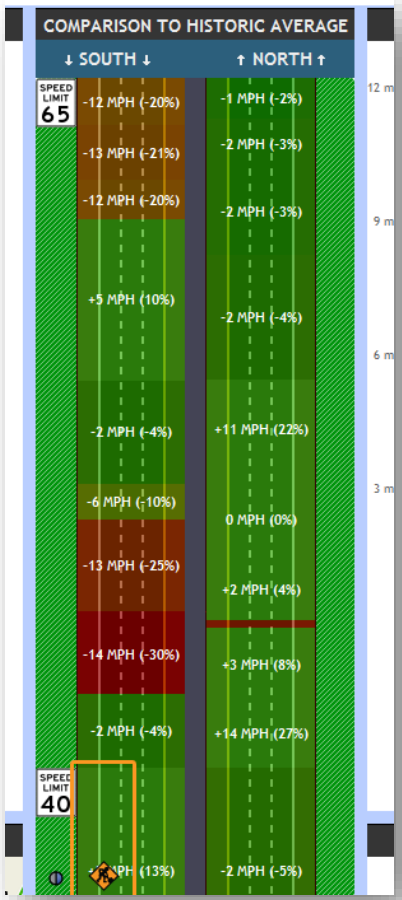
Project Information

Site Details

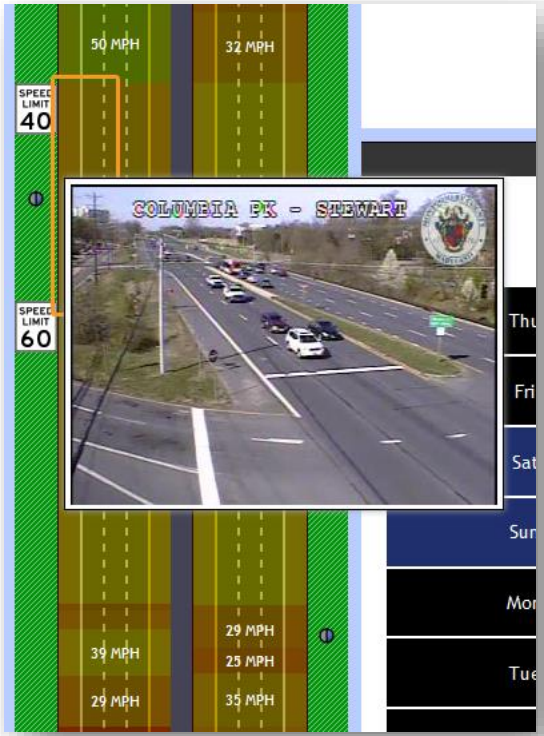
Configure Alerts



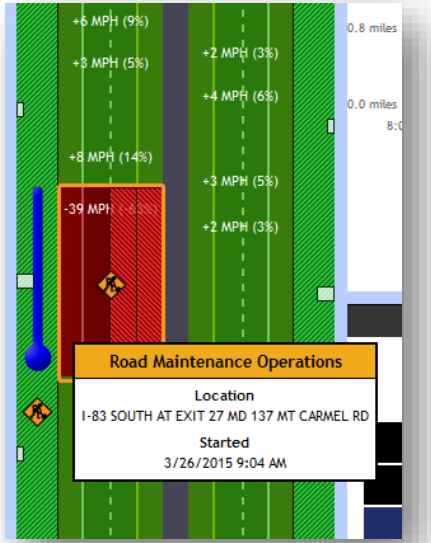
Lane Profile



Segment Speeds



Live CCTV & DMS



Bottlenecks & Nearby Events

Individual Work Zone Profile

Work Zone Performance Monitoring

Planned Closure @ US 29 SOUTH AT INDUSTRIAL PKWY

Started: Thu, Apr 17, 2014 at 09:16:31 AM

SETTINGS

Data Type...

- (•) Measured Speeds
- ( ) Comparison to Historical Average

Show...

- [x] Work Zone Bounds
- [x] Posted Speeds
- [x] Associated DMS
- [x] Nearby Cameras
- [x] Nearby Incidents
- [ ] Lane Status
- [x] Bottlenecks (when available)

5 miles upstream

5 miles downstream

Permit Information

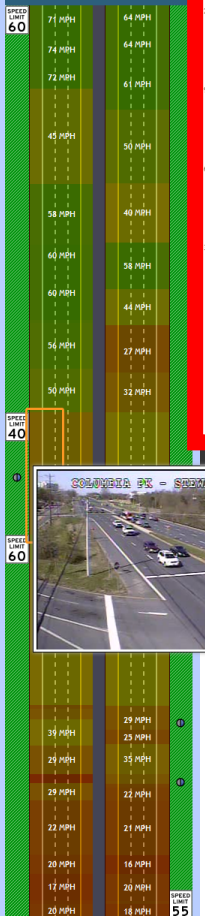
Project Information

Site Details

Configure Alerts

CURRENT CONDITIONS

↓ SOUTH ↓ | ↑ NORTH ↑

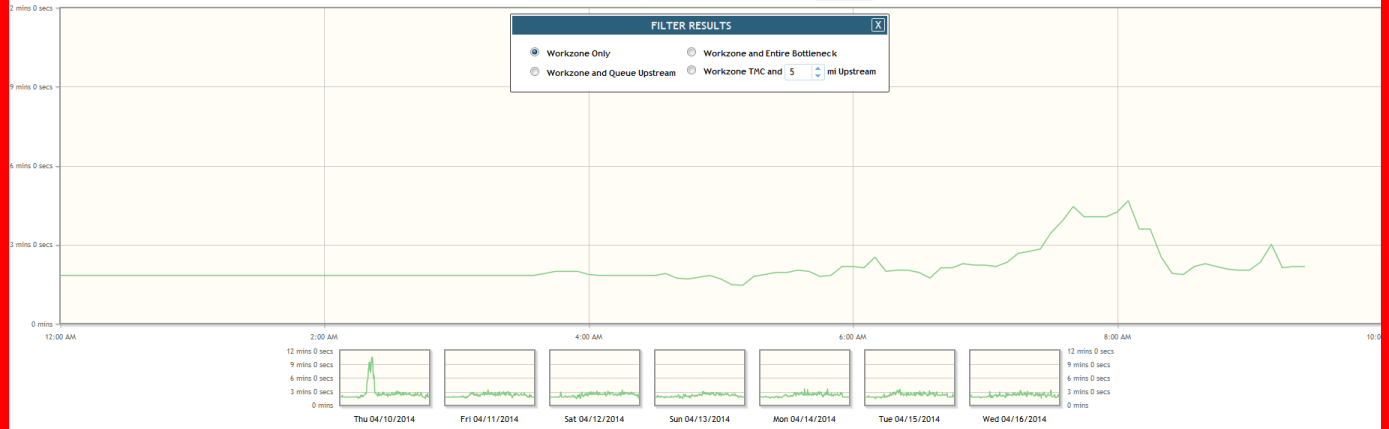


TRAVEL TIME THROUGH WORKZONE ONLY

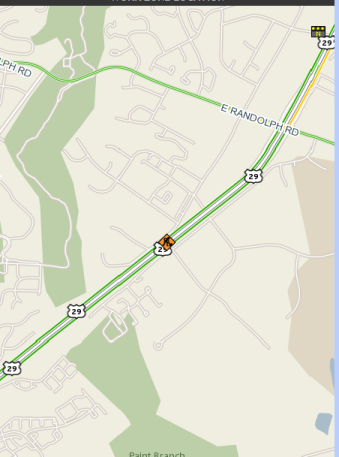
Travel Time | Through the Work Zone | Filter Results

FILTER RESULTS

- (•) Workzone Only
- ( ) Workzone and Queue Upstream
- ( ) Workzone and Entire Bottleneck
- ( ) Workzone TMC and 5 mi Upstream



WORK ZONE LOCATION



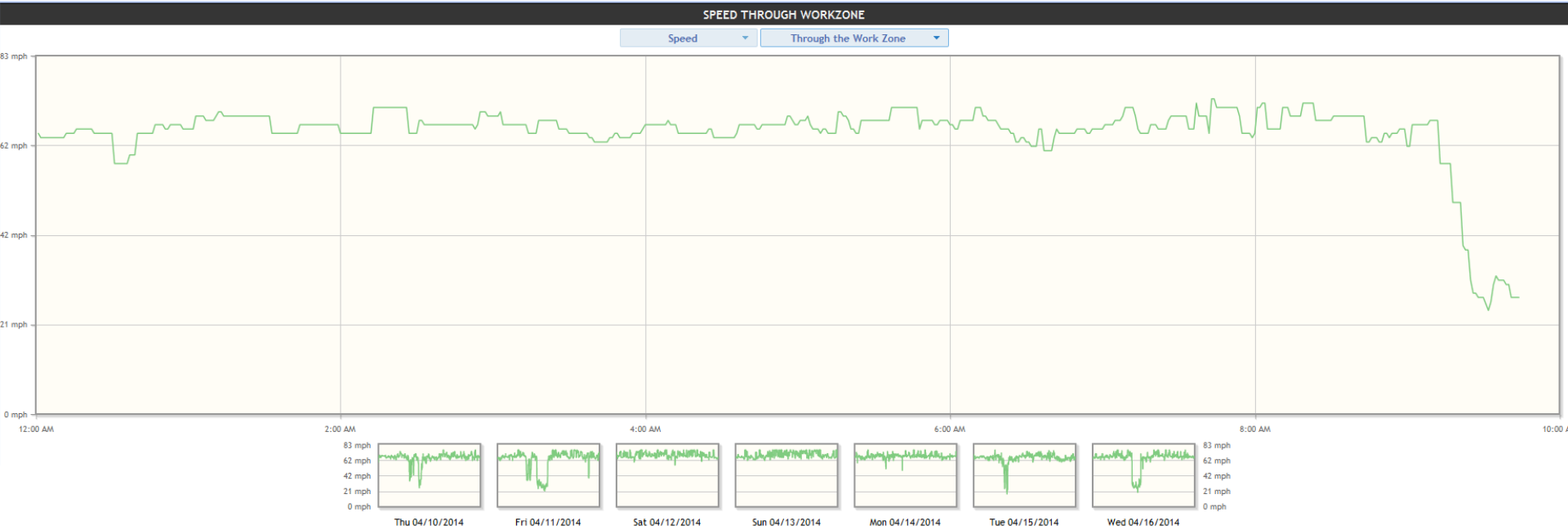
USER DELAY COST

Total User Delay Cost

	12AM - 4AM	4AM - 8AM	8AM - 12PM	12PM - 4PM	4PM - 8PM	8PM - 12AM	Daily Totals
Thu 4/10/2014	$5.78	$6,873.19	$12,665.11	$3,206.89	$2,729.29	$727.68	$26,207.94
Fri 4/11/2014	$1.43	$1,659.88	$2,890.60	$3,409.59	$2,672.82	$725.83	$11,360.16
Sat 4/12/2014	$28.72	$157.52	$2,128.63	$3,515.62	$2,832.64	$1,460.89	$10,124.02
Sun 4/13/2014	$26.27	$130.17	$903.41	$3,146.27	$2,241.61	$563.40	$7,011.13
Mon 4/14/2014	$6.28	$745.76	$2,621.76	$3,140.43	$2,590.54	$687.18	$9,791.94
Tue 4/15/2014	$4.02	$1,656.16	$3,762.04	$3,180.66	$2,815.89	$621.03	$12,039.80
Wed 4/16/2014	$13.48	$999.74	$1,930.41	$3,092.66	$2,405.12	$598.21	$9,039.62
Hourly Totals	$85.97	$12,222.42	$26,901.96	$22,692.12	$18,287.90	$5,384.23	Grand Total: $85,574.60

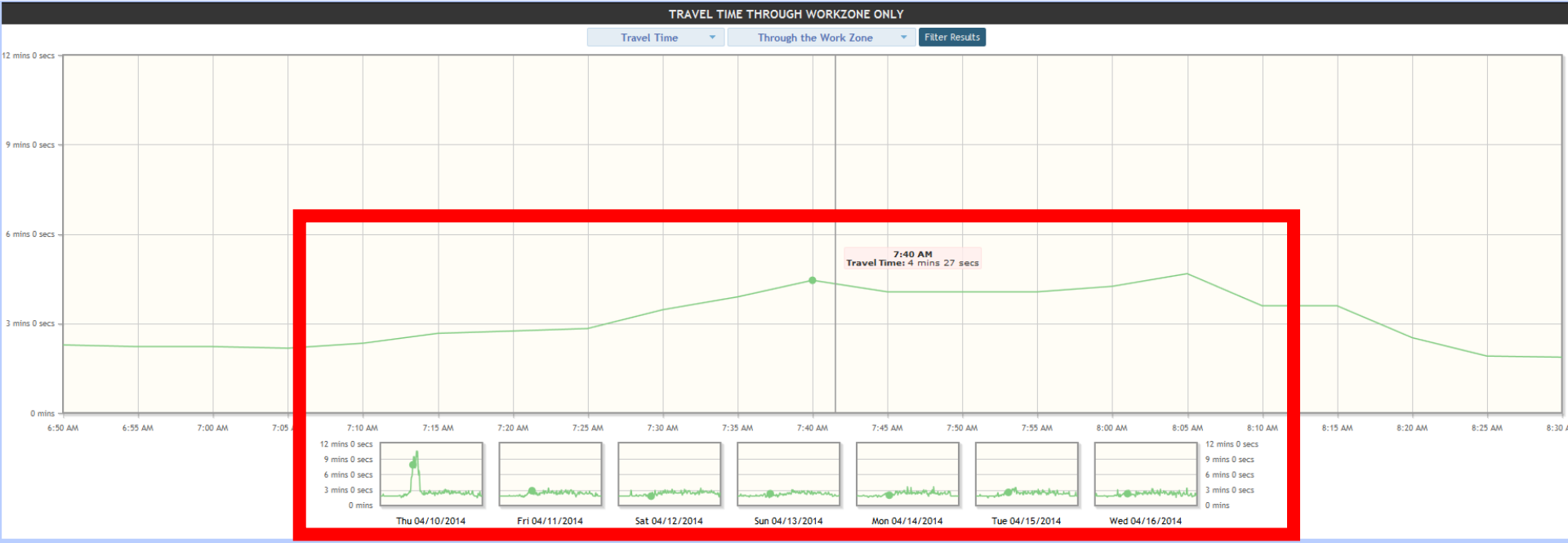
Weekend | Lowest | Highest | No Data

Performance Charts

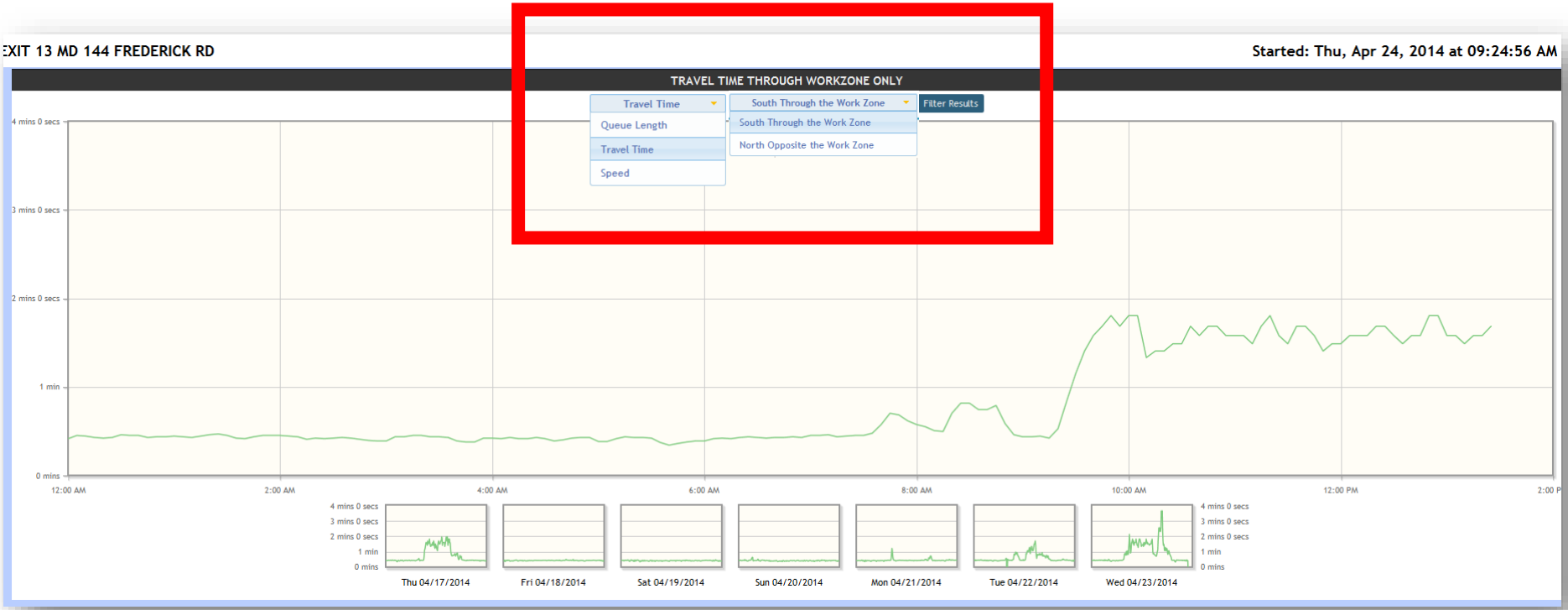


Performance Charts

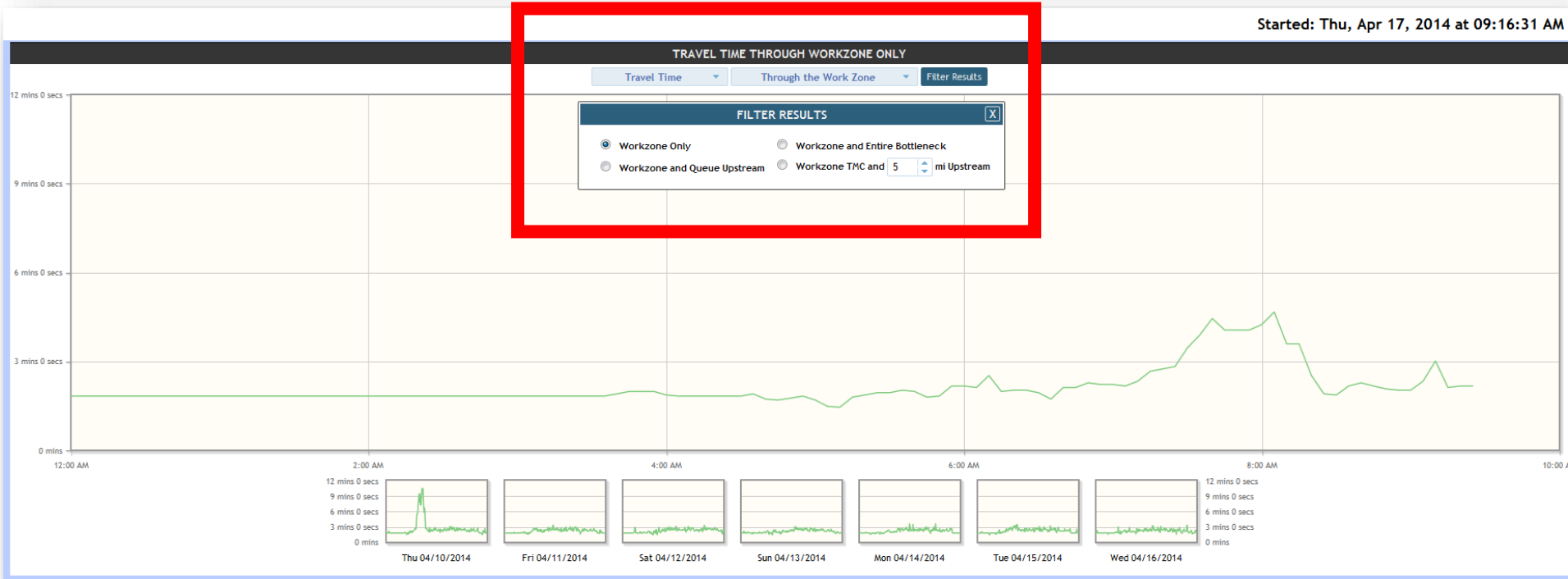
Started: Thu, Apr 17, 2014 at 09:16:31 AM



Adjusting Parameters



Filtering Results



Individual Work Zone UDC

Work Zone Performance Monitoring

	12AM - 4AM	4AM - 8AM	8AM - 12PM	12PM - 4PM	4PM - 8PM	8PM - 12AM	Daily Totals
Thu 4/17/2014	$11.52	$183.00	$9,306.97	$16,405.23	$2,958.90	$67.58	$28,933.20
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Sat 4/19/2014	$27.17	$7.65	$3.12	$22.42	$17.28	$46.01	$123.66
Sun 4/20/2014	$39.81	$24.66	$0.00	$6.13	$26.78	$18.42	$115.80
Mon 4/21/2014	$2.46	$48.75	$788.33	$103.20	$899.54	$131.35	$1,973.63
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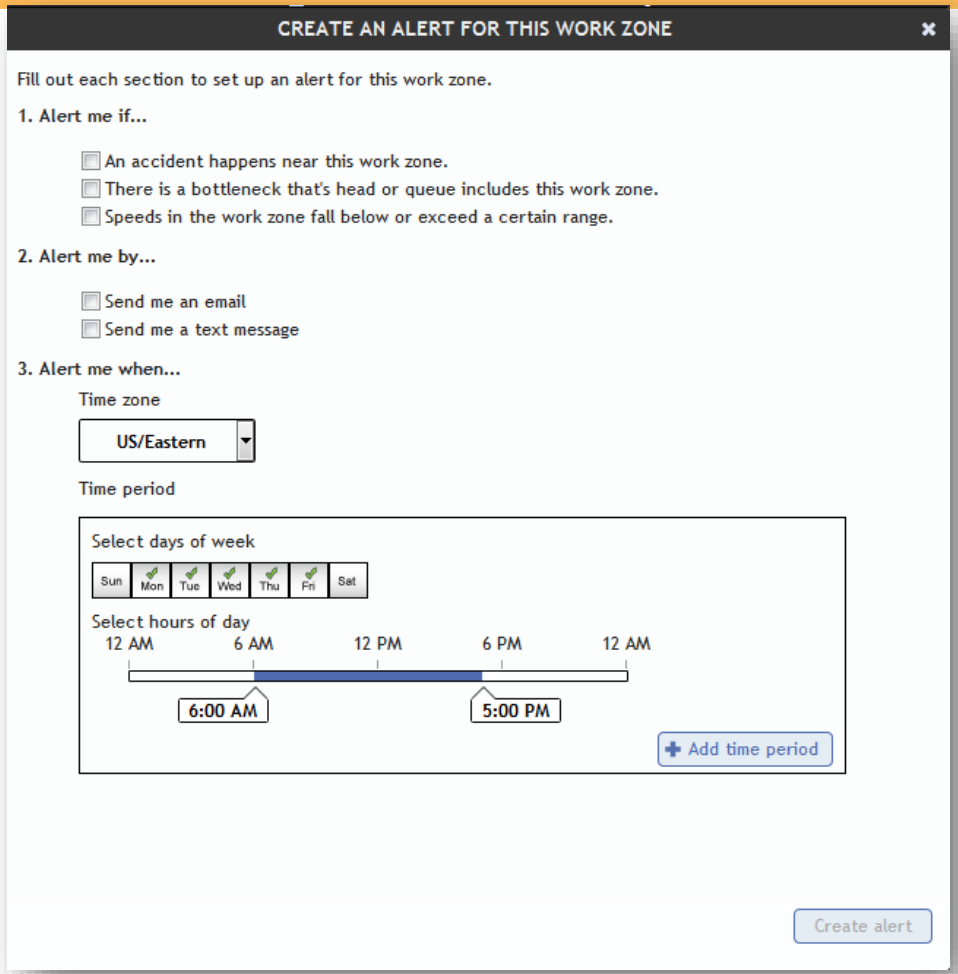
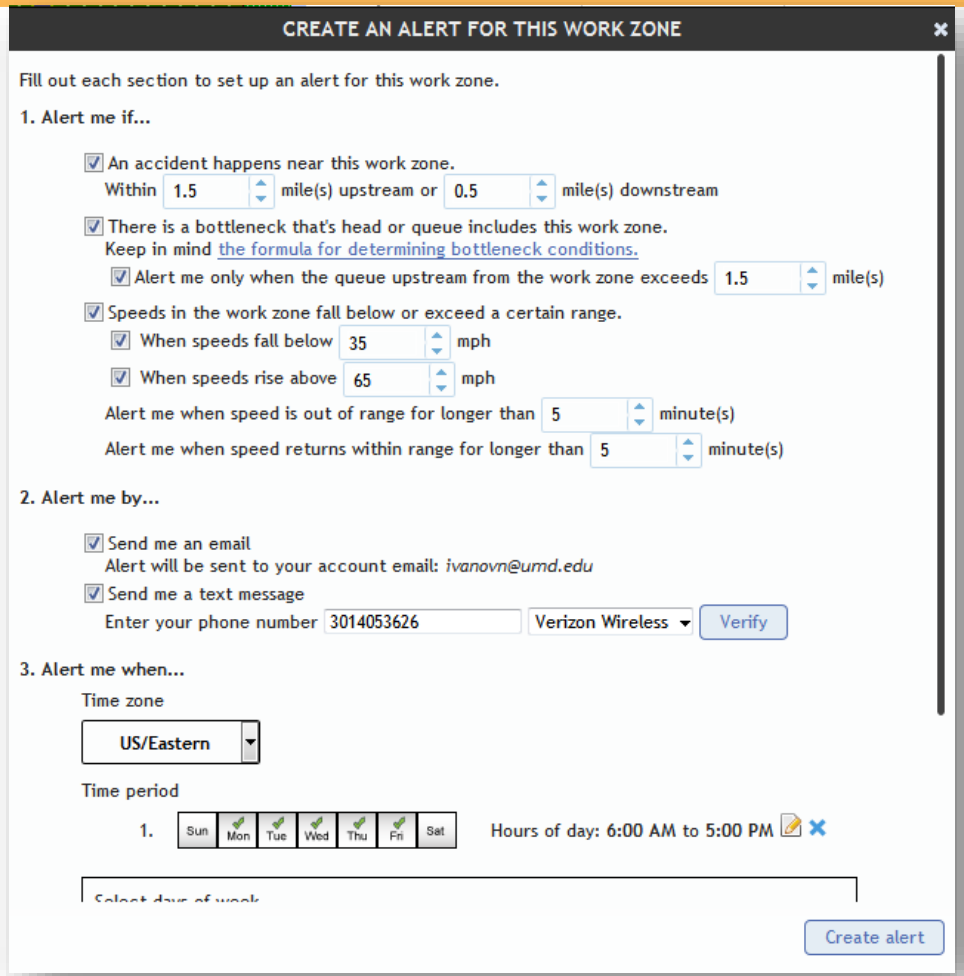
Hourly Totals	$133.04	$1,035.22	$24,525.89	$39,522.78	$22,918.53	$582.59	Grand Total: $88,718.06

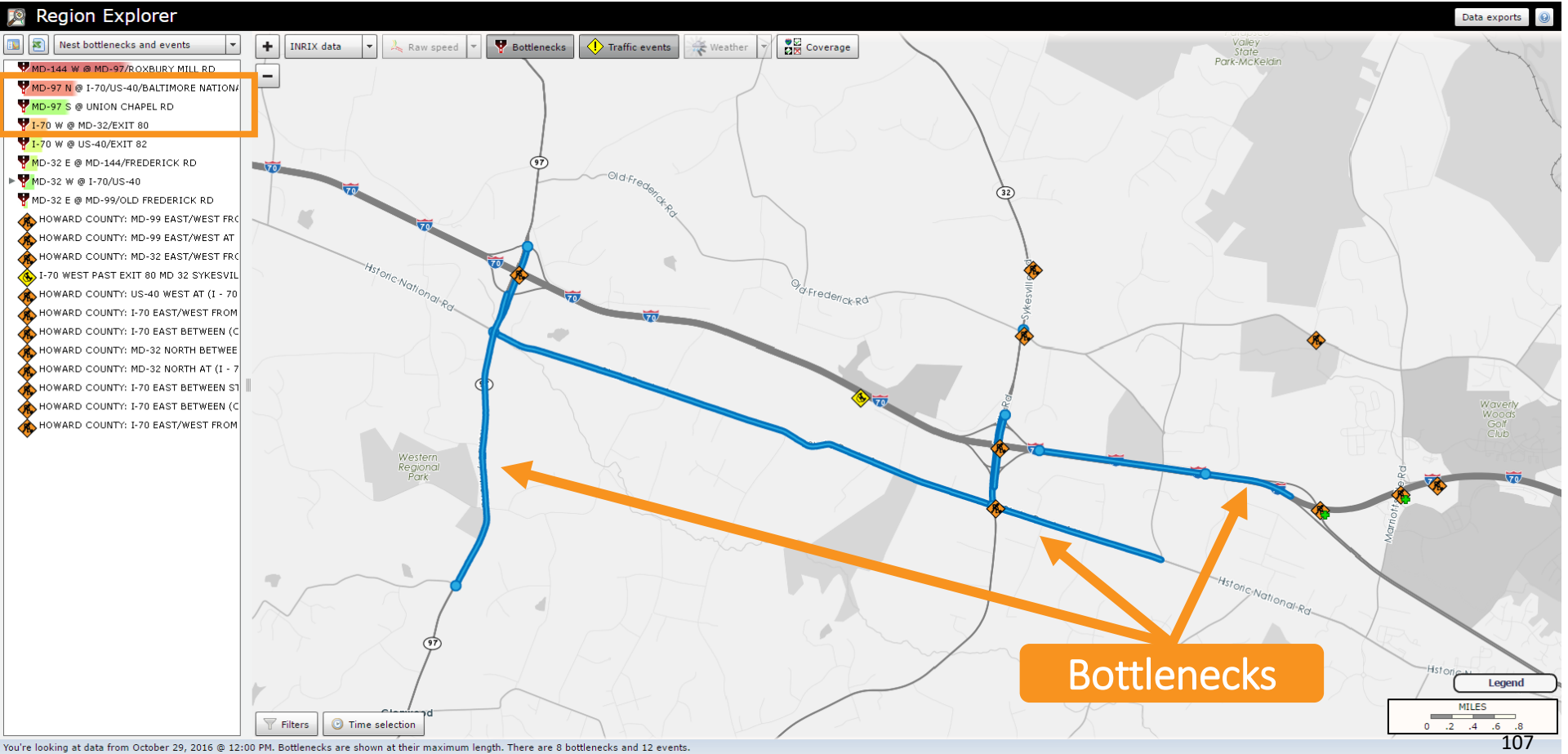
Work Zone Alerts



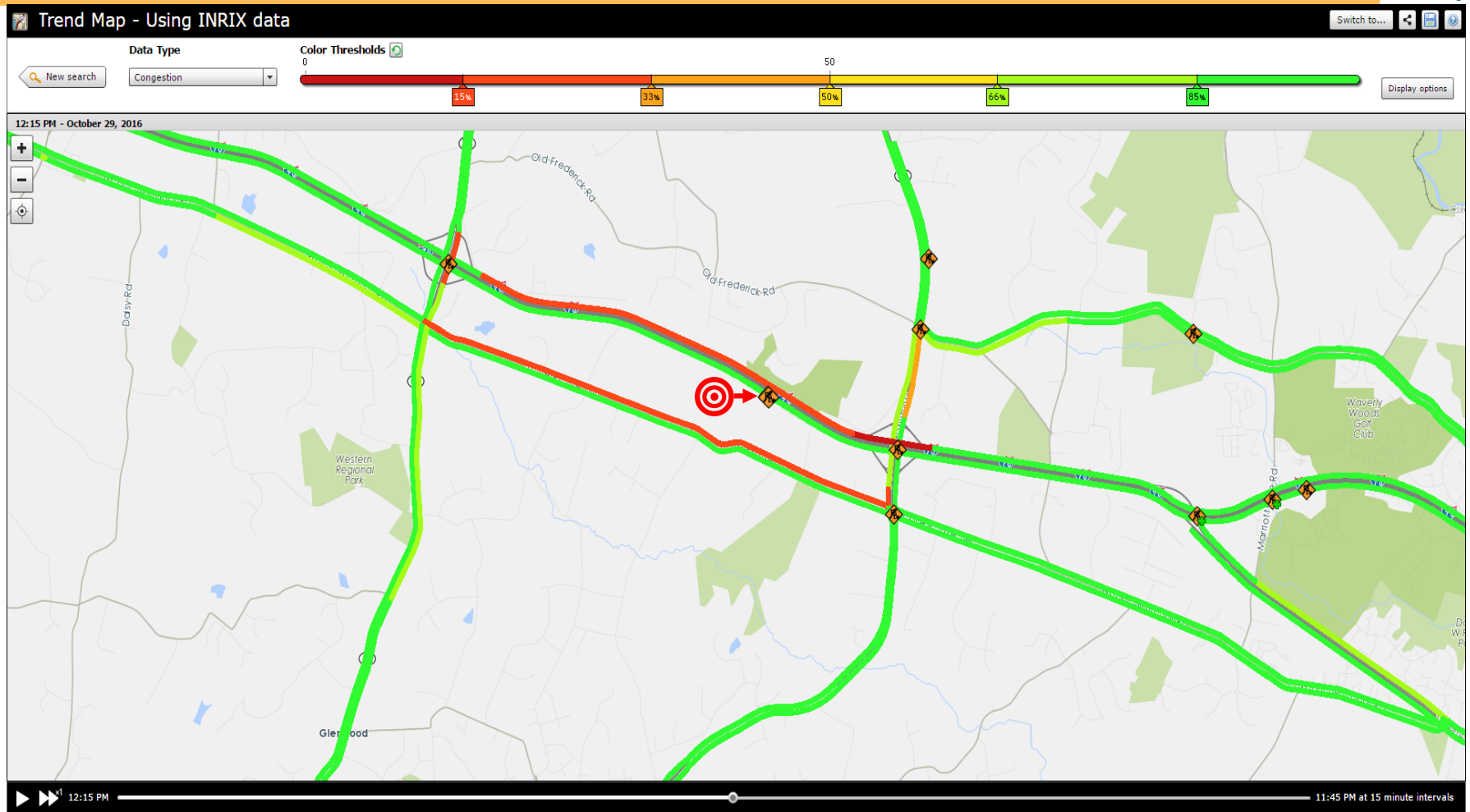
Work Zone Alerts



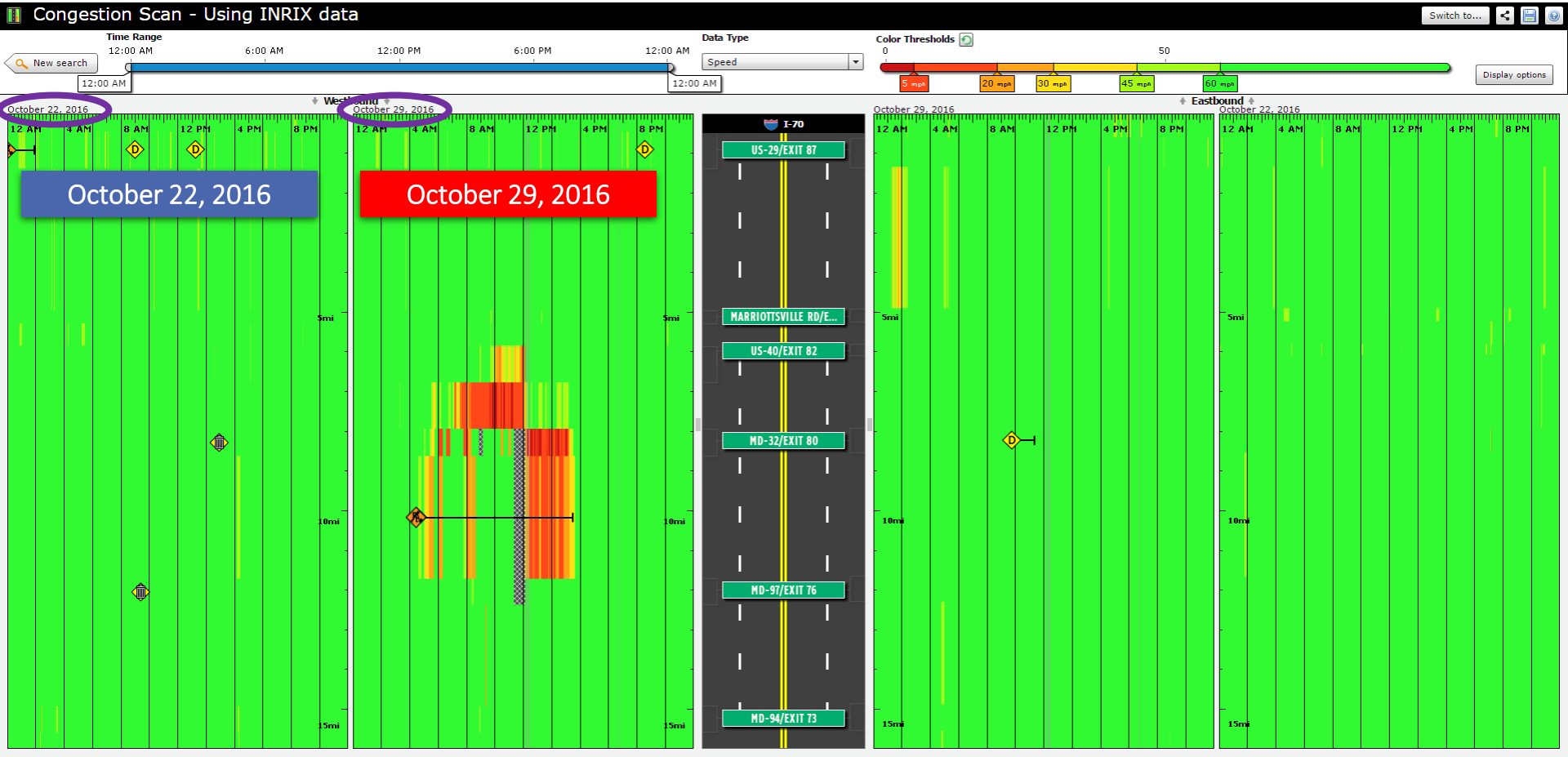
Further Analysis of Impacts – After Action Reviews (AARs)



Trend Map – Congestion Over Time



Congestion Scan – Comparison to Previous Week



User Delay Cost Incurred

Assuming an Average Value of time of:

$16.79 per hour (Passenger Vehicles)

$86.81 per hour (Commercial Vehicles)

(NOTE: User Delay is calculated any time speeds fall below free-flow)

User Delay Cost Incurred

Work Zone Performance Monitoring

	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM							7 PM	8 PM	9 PM	10 PM	11 PM	Daily Totals
10/22/16	$0.1K	$0.1K	$0.1K	$0K	$0K	$0.2K	$0.3K	$0.2K						$0.3K	$0.7K	$0.5K	$0.2K	$0.1K	$0.1K	$6.2K
10/23/16	$0.2K	$0.1K	$0.2K	$0K	$0K	$0.4K	$0.3K	$0.4K						$0.1K	$0.2K	$0.2K	$0.3K	$0.1K	$0.1K	$6.2K
10/24/16	$0.1K	$0.1K	$0K	$0K	$0K	$0.1K	$2.2K	$11.9K	$5K	$1.1K	$0.2K	$0.3K	$0.5K	$0.6K	$1K	$0.2K	$0.2K	$0.3K	$0.1K	$0K	$34.2K
10/25/16	$0.1K	$0.1K	$0K	$0K	$0K	$0.2K	$8.1K	$22.4K	$7.5K	$2K	$0.4K	$0.3K	$0.3K	$0.5K	$0.3K	$1K	$0.2K	$0.2K	$0.2K	$0.1K	$66.3K
10/26/16	$0.1K	$0K	$0K	$0.1K	$0.2K	$0.1K	$3.2K	$25.7K	$12.5K	$2.1K	$0.2K	$0.3K	$0.2K	$0.3K	$0.4K	$1.1K	$0.2K	$0.4K	$0.1K	$0.1K	$61.9K
10/27/16	$0K	$0.1K	$0K	$0K	$0K	$0.2K	$2.6K	$6K	$2.5K	$0.5K	$0.4K	$0.2K	$0.3K	$0.2K	$3.9K	$0.8K	$0.2K	$0.1K	$0.1K	$0.1K	$44.6K
10/28/16	$0K	$0K	$0.1K	$0K	$0K	$0.1K	$1.8K	$4.2K	$6.8K	$0.9K	$0.2K	$0.2K	$0.2K	$0.3K	$0.6K	$0.3K	$0.4K	$0.3K	$0.1K	$0K	$72.1K
10/29/16	$0.1K	$0.4K	$0.1K	$0K	$0.1K	$0.3K	$1.5K	$2.4K	$3.6K	$9.3K	$13.8K	$14.7K	$9.4K	$8.9K	$7.8K	$0.4K	$0.3K	$0.3K	$0.1K	$0.1K	$76.7K
10/30/16	$0.1K	$0.1K	$0.1K	$0.1K	$0.3K	$0.1K	$0.3K	$0.5K	$0.4K	$0.3K	$0.2K	$0.3K	$0.2K	$0.1K	$0.2K	$0.3K	$0.3K	$0.2K	$0.1K	$0.2K	$7.2K

Normal Saturday
= $6k - $7k

Daily Totals

$6.2K

$6.2K

$34.2K

$66.3K

$61.9K

$44.6K

$72.1K

$76.7K

$7.2K

Oct. 29th Saturday
= ~$77k
Worse than Friday
the day before!

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Now that you have heard the presentations-

Questions?

- Remaining Questions from the CHAT Box

Wrap Up

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Thank You!